

THE NAVY'S ENERGY & ENVIRONMENTAL MAGAZINE

Currents

summer 2016

PMRF Establishing **NEW HIVES** to Protect
Honey Bee
population
& Minimize Interference with Base Activities

New Environmental Director's
Entomology Skills
Creating a Buzz

LMR Program Launches New Project Initiatives

SSC Pacific Scientists Mimic Marine Mammals to Build a
Better Sonar

MCAS Cherry Point Implements Innovative Water Quality
Monitoring System



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N45 Outlook



THIS IS MY final column as director of OPNAV N45. By the time this magazine crosses your desk and appears online, Rear Admiral Lou Cariello will have taken over the reins here and be applying his experience to the numerous issues in which we're engaged. It's complex work that is vital for executing the Navy mission today and maintaining capability for the future. I'm excited about the opportunities he'll have to both lead and learn from the dedicated staff here at N45.

As policymakers and subject matter experts, we must continue minimizing and mitigating risks to the training and testing our forces require. An aspect of this is our approach for interfacing with our regulatory partners for environmental permits. With the challenges those agencies face in analyzing huge numbers of permit requests, the Navy must do everything in our power to ensure that the requests we submit for regulatory review meet all key requirements on the first go round. We also need to communicate early and often with regulators to help create shared, realistic expectations for our consultations. Success on this front can help keep our training and testing on track—but failure could force us to delay activities that are essential for readiness.

Contamination of drinking water by perfluorinated compounds (PFC) from firefighting chemicals continues to be of concern for the Navy. Over the past several months as the U.S. Environmental Protection Agency has increased awareness and created a lifetime health advisory, we've ramped up sampling efforts on and around facilities where firefighting training and/or aviation accidents have occurred and are providing bottled water where needed to ensure people have safe water to drink. We continue to inform affected communities, develop policies and funding plans to eliminate PFCs from the supply chain, and look at options for remediating contaminated water. We must, and we will, do the right thing to protect our own workforce and our neighbors near our installations.

The examples above are just two of a host of important energy, environmental, and compatibility issues which N45 and our colleagues throughout the Fleets and systems commands are working daily, with the clear goal of empowering the Navy to perpetually meet its national security mission.

In closing, I offer my sincere thanks for all you do. It has been an honor and a privilege to serve with you. 📍

Rear Admiral Doug Morton
Director, Chief of Naval Operations Energy and Environmental Readiness Division



PMRF Establishing **NEW HIVES** to Protect **Honey Bee** **POPULATION** & Minimize Interference with Base Activities

New Environmental Director's Entomology Skills Creating a Buzz

The new environmental director at the Pacific Missile Range Facility (PMRF) is building new hives to establish a healthy bee population on base, conduct associated diagnoses, and ultimately guard against the potentially adverse impacts of swarming events on base.

The Challenge

PMRF at Barking Sands, located on the western side of Kauai, Hawaii, is the world's leading multi-dimensional integrated test and training range. The installation simultaneously supports surface, subsurface, air and space operations. The installation is contained within a strip of land 7.5 miles long and one-half mile wide between the ocean and mountains.

Much of the land adjoining the installation is used for agriculture, which benefits from the area's generally warm and dry climate. This climate also contributes to numerous honey bee swarms. PMRF can see nine to 15 swarms during the year, with peak season occurring during the summer months.



Honey bee swarm hanging from a tree branch.



Hive damaged by small hive beetle larvae in the "slime" stage.
USDA



Deadly parasitic varroa mite on the back of a honey bee.
Scott Bauer

Bee swarms at PMRF, particularly near the air strip, typically have been managed as a pest concern for a number of reasons. First is bio-security. With aircraft coming in and out, there is potential for varroa mite (*Varroa destructor*) and other honey bee threats to be introduced. Varroa mite, a significant threat to all honey bee colonies, has not yet been detected on Kauai. Because PMRF is a

small installation with limited staff, it does not support an animal and plant health inspection service.

Second, if swarms are not captured and put into hives, the bees can establish their colonies where they may pose problems for buildings and humans. If hives become established in buildings not only they can damage the structure but the bees could become defensive and sting people perceived as a threat to the colony.

PMRF can see nine to 15 swarms during the year, with peak season occurring during the summer months.

The first spring after John Nelson, PMRF's new environmental director, arrived he received a call about a swarm. While swarms were typically handled by PMRF's pest control officer, Nelson's entomology training fueled his interest in checking out the swarm. When a staff person from Hawaii's Department of Agriculture (HDOA) arrived to collect the swarm, he told Nelson that he would freeze the swarm to kill it and send samples to HDOA's Bee program to test for parasites.

The Purpose Behind This Effort

Nelson thought there might be another way to address the concerns while also protecting the beneficial and at-risk bee populations. He had been exposed to beekeeping as a child—his family had hives when he was growing up—and it felt like something he could do. He proposed



The Pacific Missile Range Facility.

establishing an apiary where swarms could be placed into hives, inspected for potential pests and protected, which is consistent with Federal guidance to protect honey bees and other pollinators.

Honey bees (*Apis mellifera*) contribute to an estimated \$14.6 million in U.S. crop production, making them critical contributors to the country's food supply. Their populations are on the decline worldwide. A recent United Nations report estimated that 40 percent of invertebrate pollinators, including bees and butterflies, are facing extinction. (For a copy of the report, visit www.ipbes.net/article/press-release-pollinators-vital-our-food-supply-under-threat.) One of the more publicized honey bee concerns is colony collapse disorder (CCD) in which managed hives suffer from the rapid loss of adult worker bees. Although no single cause for CCD has been clearly identified, a number of issues have been suggested including susceptibility to threats from varroa mite, small hive beetle, bee brood diseases and pesticides, including neonicotinoids. Other important pollinators, such as bumblebees and butterflies, also are at risk.

Recognizing the seriousness of declining pollinator populations, President Barack Obama issued a Presidential Memorandum in 2014 to create a "Federal Strategy to Promote the Health of Honey Bees and Other Pollinators." The memorandum, noting the "breadth, severity, and persistence of pollinator losses," established the Federal Pollinator Health Task Force, co-chaired by the Secretary of Agriculture and the Administrator of the U.S. Environmental Protection Agency. The task force which included

Presidential Memorandum for a National Strategy on Honey Bee and Pollinator Health

President Barack Obama issued his Presidential Memorandum on 20 June 2014 to create the Federal Pollinator Health Task Force. He charged the Task Force with creating a "Federal Strategy to Promote the Health of Honey Bees and Other Pollinators." The Task Force is co-chaired by the Secretary of Agriculture and the Administrator of the U.S. Environmental Protection Agency. Selected documents associated with the President's Memorandum and resulting from the task force's work can be found at the following links:

Presidential Memorandum—Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators

- <https://www.whitehouse.gov/the-press-office/2014/06/20/presidential-memorandum-creating-federal-strategy-promote-health-honey-b>
- <https://www.gpo.gov/fdsys/granule/FR-2014-06-24/2014-14946>

National Strategy to Promote the Health of Honey Bees and Other Pollinators

- <https://www.whitehouse.gov/sites/default/files/microsites/ostp/Pollinator%20Health%20Strategy%202015.pdf>

The Department of Defense's Role in the National Strategy to Promote the Health of Honey Bees and Other Pollinators (2015)

- www.dodpollinators.org/Pollinator_Health_Strategy_2015_for_DoD.pdf

Pollinator Friendly Best Management Practices on Federal Lands

- www.fs.fed.us/wildflowers/pollinators/BMPs/documents/PollinatorFriendlyBMPsFederalLandsDRAFT05152015.pdf



LEFT: Swarm of bees on a swarm trap at PMRF.
 ABOVE: Frame of recently transferred comb with honey, pollen, bee bread, open brood, and sealed brood present.
 John Nelson

representatives of all Executive Branch departments, including Department of Defense, and other key federal government offices, was charged with crafting the federal strategy.

In addition to research into the causes of population declines and public education efforts to detail ways that citizens could support pollinators, the strategy specifies steps to be taken on federal facilities. It provides federal facility managers with needed information to “promote the overall life-cycle of pollinators at Federal facilities—improved foraging, reproduction, shelter, and hibernation.” (See the addendum to *Sustainable Practices for Designed Landscape* guidance, 2014, page 6.)

What PMRF is Doing

Establishing hives requires equipment, including hive structures and beekeeping suits. Nelson saw two primary ways to get hives structures—buy them online and have them shipped (prohibitively expensive to Hawaii) or build them. Nelson reached out to the local community and found woodworkers, including the pest control contractor at PMRF, willing to help. Not only did the pest control contractor have beekeeping experience, but he also was a woodworker. The team started building and completed the first Langstroth hives in summer 2015. (See our “Langstroth Hives” sidebar for more information.)

Nelson has created two apiaries (placed hives) by capturing swarms



Beekeeper (Randy Nakama, Manu Kai) observing the remainder of bees from a swarm trap make their way into a newly established hive.
 John Nelson

before they established colonies. The apiaries are at two locations on the installation, one at the north end and the other at the south end. These locations have been carefully selected to avoid more populated and frequented areas of the base. In addition, he has placed several swarm traps around the base near buildings and other locations where swarms might try to establish a new colony. The traps are large, bucket-

The traps might help to prevent potential conflicts from a colony becoming established in buildings or near the air strip.



LEFT: Newly established PMRF bee hive (brood box) after transferring a swarm of feral bees.
 ABOVE: Frame of recently transferred comb with honey, pollen, bee bread, open brood, and sealed brood present.

John Nelson

size containers that include a lure. When a swarm gets into a trap, Nelson and his team can move the swarm to one of the constructed hives. While there is no guarantee that the swarms will only go to these traps, they make it easier to capture the swarms. The traps might help to prevent potential conflicts from a colony becoming established in buildings, near more populated parts of the base or near the air strip. The team is prepared to establish ten hives during the 2016 season.

While established colonies sometimes can be moved, one of Nelson's early experiences demonstrated potential problems. A colony discovered underneath a temporary building was near the building entrance and needed to be removed. The team attempted to move the colony by transferring the layers of comb into Langstroth hive frames. While such a transfer can be done successfully under good conditions, this one did not proceed as

hoped. As the ambient temperature rose, the wax of the brood and honey combs began to soften and the combs were falling apart. During the process some parts of the combs overlapped, making the colony vulnerable to small hive beetle attack. Ultimately, after the colony was moved into a hive, the hive beetles overwhelmed the hive and it failed.

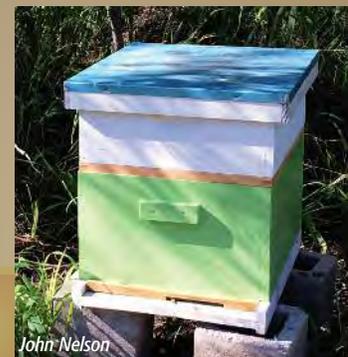
Although that colony did not succeed, some of the collapsed combs from that relocation effort were full of kiawe honey—known to be light and flavorful. The honey filled several jars and provided a vehicle for generating added interest for the apiary effort.

To give the other new hive colonies a "leg up" Nelson provided sugar water during times that nectar was not readily available. In a fashion similar to hummingbird feeders, supplementing nectar sources with sugar water can help to establish and support healthy hives. Healthy hives are better able to withstand and control the inevitable

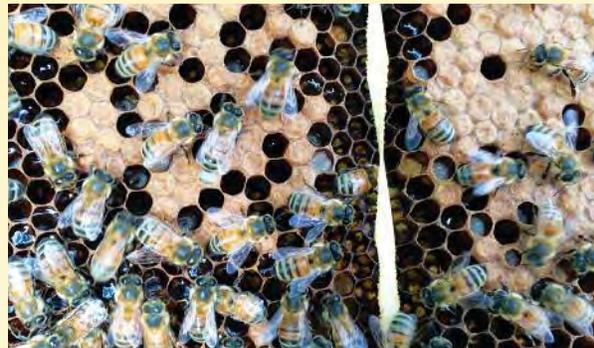
Langstroth Hives

John Nelson is using Langstroth hives for the PMRF apiary. Of the three types of hives currently popular with beekeepers, the Langstroth is probably the one most people recognize. Patented in 1852 and developed by Lorenzo Langstroth, the hive is composed of stackable boxes with frames. The larger brood box holds ten deeper frames where the queen starts laying her brood and worker bees draw comb (wax). The smaller boxes placed over the brood box are called "supers" or "honey supers" where worker bees store excess honey.

The first PMRF hive has a full brood box and the bees are starting to draw wax and store honey in the first super box. In the other successful hive, the bees are still building out the brood box.



John Nelson



LEFT: Queen bee surrounded by ring of attendant workers. This only happens when the queen is at rest.

ABOVE: Frame of brood comb with open and sealed brood present.

John Nelson

presence of some small hive beetles. During the spring, with the abundance of kiawe (*Prosopis pallida*, a type of mesquite) on PMRF, the hives have a significant nectar source during its flowering period.

The initial hives were inspected, sampled and approved by the state apiarist (beekeeper). PMRF will continue to work with the state, providing bee, pollen and wax samples that can be tested for possible parasites and pesticide loads, and bee tissue for genetic testing. These hives could become sentinel hives, providing timely valuable information about the colonies' health and potential threats to honey bee populations on Kauai, as well as provide insights into which strains of bees are present and succeeding. (For more on honey bee strains, see our "Honey Bee Basics" sidebar.) This cooperation might be able to contribute data to research on colony collapse disorder.

Public Outreach & Education

The PMRF bee project offers numerous education and outreach opportunities. Public education efforts, both on base and off, can help people to:

- Understand the critical role honey bees and other pollinators play.
- Learn more about the precipitous declines in honey bee and pollinator populations.
- Become more aware of ways to support pollinators.
- Recognize that honey bees are generally non-aggressive.
- Distinguish between honey bees and more worrisome wasps (also common at PMRF).

Understanding more about bee swarms—why swarms occur, what they look like and what people can do when they see a swarm—is a valuable first step. Swarms happen when a queen bee and about one-third to one-half of the workers leave

to establish a new colony. In the existing hive a new queen will emerge. The departing worker bees surround the queen to protect her while other bees scout out a location to establish a new hive. Often swarms are seen on tree branches, on fences or under building eaves. When bee traps are set with lure, the bees might swarm on the trap.

Important things to keep in mind when finding a swarm:

- Swarming bees typically are not defensive and do not pose a threat.
- Do not disturb the swarm.
- Do not spray or try to kill the bees.
- Call a beekeeper. They are eager to capture swarms and know how to do it safely.

At PMRF, anyone sighting a swarm can contact the Environmental Division and Nelson and his team will capture the swarm.

In addition to working with HDOS's bee program, Nelson coordinates with other beekeepers, environmental groups and local schools on the island. He is an active member of the Kauai Beekeeper Association and the local community college's apiary

This is not rocket science. With a little research, anyone can take up beekeeping.

—John Nelson

program. Some of the goals of these connections include:

- Advancing honey bee awareness and advocacy on the island of Kauai.
- Improving collaboration on bee-related issues.
- Assisting, educating and sharing with fellow beekeepers.
- Promoting beekeeping by creating a positive image of honey bees, beekeeping, and bee products.

Nelson also believes making these efforts is consistent with PMRF's commitment to being a good neighbor on Kauai and to implementing the full spirit of Executive Order 13352, "Facilitation of Cooperative Conservation."

Looking forward, Nelson hopes to establish a demonstration "bee yard." This would provide a safe setting in which people could get close to the hives, learn more about the bees and beekeeping. It is exciting for people to

hold a frame of bees, see the eggs and developing larvae, and see the queen. It helps to demystify the hive and makes the bees a little less scary. Eventually Nelson hopes to expand the project to provide more hands-on education on base and to support environmental education in nearby schools.

Nelson also would like to expand his efforts to providing direct support for other pollinators, particularly native pollinators. Hawaii's only native bee (*Hylaeus*), commonly known as the yellow-faced bee, also has been in decline due in part to habitat loss. These are species of solitary bees (meaning they do not establish colonies like the honey bee) and important pollinators for native Hawaiian plants. Planting native species on base could support these and other native pollinators, including butterflies and birds.

Conclusions

With the increasing attention to the plight of honey bees and other



John Nelson with a smoker preparing to inspect a hive.
Randy Nakama

pollinators, Navy environmental managers who haven't done so already can anticipate adding pollinator protection plans to their Integrated Natural Resources Management Plans. In locations that need to respond to honey bee swarms, establishing swarm traps and being prepared to capture and transfer swarms into hives is a win-win for the installation and for the honey bees. Managing honey bees this way provides a unique channel for public outreach. This is one more way the Navy can demonstrate its stewardship of the land and natural resources on installation.

While Nelson might be an entomologist, he is quick to note, "This is not rocket science. With a little research, anyone can take up beekeeping." 🍯

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The Basics About Honey Bees

There are over 20,000 types of bees world-wide. The most commonly known is the European or western honey bees are *Apis mellifera* (Apis: bee; mellifera: honey-bearing). They are social and establish colonies that include a queen, a limited number of male drones and female workers, each with specific responsibilities within the colony. The queen is the only bee within the colony that can lay eggs. She only leaves the hive to mate with drones or to establish a new colony. Workers forage for nectar and tend and build the hive.

Within the *Apis mellifera* species are various strains or subspecies with different characteristics beekeepers sometimes consider when establishing managed hives. There are German or "black" bees (*A. m. mellifera*), one of the first honey bees brought to the United States, are a more defensive strain; Italian honey bees (*A. m. ligustica*), are good honey producers and docile; Carniolan bee (*A. m. carnica*), are particularly docile but quick to swarm; Caucasian bees (*A. m. caucasica*) from the Ural mountain foothills are another more defensive strain.

The PMRF honey bees are from feral swarms and their genetics are not currently known.



Rob Flynn

LMR Program Launches New Project Initiatives

Efforts Continue to Expand the Navy's Knowledge of Marine Mammals

THE LATEST ROUND of Living Marine Resources (LMR) program projects continue to support the Navy's efforts to reduce potential impacts to marine mammals while meeting its at-sea training and testing requirements.

which of those should be expanded into full proposals. Full proposals receive similar scrutiny. Following approval from the LMR program's resource sponsor, the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV

- Is associated with an environmental constraint or regulatory driver.

Submitted needs are validated and ranked by the LMRAC, and then recommendations are made to

Results will ensure better estimates of potential disturbance and harassment for future naval training and environmental impact statement assessments.

The LMR program is responsible for applied research and works both to address the Navy's key research needs and to transition the results and technologies for use within the Navy's at-sea environmental compliance and permitting processes.

The newly started fiscal year (FY) 2015 projects were selected through a carefully considered process that the program undertakes each year. This process begins with identifying key Navy needs followed by issuing a Broad Agency Announcement (BAA) to solicit pre-proposals to address those needs. The program's advisory committee, the Living Marine Resources Advisory Committee (LMRAC), reviews the pre-proposals and recommends

N45), selected proposals are identified for funding.

LMR Investment Areas & Needs

The annual needs identification process is organized within five defined investment areas. (See our sidebar "The Basics About the LMR Program" for more details.) Anyone within the Navy may submit needs for consideration by the program. The needs must fall within the defined investment areas and meet one or more of the following conditions:

- Addresses research challenges being faced by the Navy community
- Identifies an existing gap in knowledge, technology and/or capability

OPNAV N45. (A guide for submitting needs is available at www.lmr.navy.mil under "Needs.")

For FY15 funding, the BAA requested pre-proposals to address the following three needs:

1. N-0077-15: Population Density Estimation from Passive Acoustic Monitoring Data
2. N-0088-15: Marine Species Monitoring Data Collection Toolkit Development
3. N-0096-15: Hearing Measurements in a Broad Range of Marine Mammal Species

The program received 63 pre-proposals, of which 19 were developed into full proposals. Of those 19,

eight “new start” projects were selected for the FY15 funding cycle.

NEED: Population Density Estimation from Passive Acoustic Monitoring Data

The Navy uses passive acoustic monitoring (PAM) for a number of environmental monitoring needs, including detecting the presence of marine mammals and classifying what species are present. PAM also offers the Navy a potentially powerful and beneficial tool to estimate the density (i.e., number of individuals) for species of concern in situations where other methods (e.g., visual observation) are infeasible or prohibitively expensive. Estimating the number of animals present using PAM data requires a level of data collection planning, metadata collection, and external calibration of detection rates that is not necessarily required for other PAM applications.

From 24 pre-proposals received, three were selected for FY15 funding and are now underway.

Passive Acoustic Density Estimation of Baleen Whales: Using Sonobuoys to Estimate Call-Rate Correction Factors

Project number: 16

Principal Investigator: Shannon Rankin, Southwest Fisheries Science Center

This project will work to improve animal density estimates of baleen whales in the California Current and the Navy’s Southern California Offshore Range (SCORE) by combining sonobuoy data with visual sightings to estimate the correction factor needed to convert call density data to whale density data. (Note: The California current is a southward flowing offshore current that traverses the west coast of North America from Canada to Baja California.) The sonobuoys used are equipped with signal processing technology that works in conjunction with PAMGuard, a widely used marine mammal passive acoustic processing program. The density of whales will be compared over the entire study area using visual line-transect survey methods



Parts of a SSQ-Q53F sonobuoy after being removed from its housing.

during daylight hours and acoustic point-transect survey methods during night hours.

Sonobuoys offer several benefits as a PAM method. They are used extensively by the Navy, and surplus sonobuoys have proven valuable for detection and localization of baleen whales. Deployment of sonobuoys requires minimal experience and can be conducted from a variety of platforms (airplanes, helicopters, ships of various sizes), which allows for opportunistic monitoring. Data collection can be conducted in real-time, allowing for a short turnaround between identifying a need and obtaining data and density estimates for baleen whales in a given area.

Blue and Fin Whale Density Estimation in the Southern California Offshore Range Using PAM Data

Project number: 17

Principal Investigator: Ana Širovic, University of California San Diego, Scripps Institution of Oceanography

This project focuses on developing spatially and temporally explicit density estimates for blue and fin whales in the Southern California (SOCAL) range to provide the Navy with a realistic, quantitative assessment of levels of impact from Navy training activities.



Team deploying an acoustic and video tag on a blue whale.
A. Allen, NMFS permit 14534



One of the earlier acoustic tags (BPROBE) deployed on a fin whale off Tanner-Cortez Bank in 2003 as part of past study of fin and blue whale calling.

The project team is leveraging results from work completed under the Office of Naval Research (ONR), utilizing data from acoustic tag deployments from the SOCAL Behavioral Response Study (BRS), and will also perform additional acoustic tag data collection, using newly available long-term tags. (For more on SOCAL-BRS, see our sidebar “Two Foundational LMR Projects.”) This will allow researchers to evaluate the effect

of bias in call-rate estimation from short-term tag deployments, which were the norm during the earlier data collection. The focus of tagging will be on fin whales where existing data are more limited, but will also supplement available blue whale data. Results will ensure better estimates of potential disturbance and harassment for future naval training and environmental impact statement assessments.

DECAF-TEA: Density Estimation for Cetaceans from Acoustic Fixed Sensors in Testing and Evaluation Areas

*Project number: 19
Principal Investigator:
Len Thomas, University of
St. Andrews*

Much of the PAM-based density estimation work now taking place occurs on Navy testing ranges where there are pre-existing arrays of cabled hydrophones. However, because a large amount of the Navy’s activity takes place away from these instrumented ranges, methods applicable to such non-instrumented areas need to be fully developed, demonstrated and validated.

This project will demonstrate and validate a method for passive acoustic density estimation that can be used across a range of species, environments and temporal scales. The project team will deploy retrievable, bottom-mounted

passive acoustic sensors adjacent to or overlapping the Southern California Anti-Submarine Warfare Range (SOAR). Data from these sensors, in conjunction with estimates of vocalization rates from existing and ongoing studies, will be used to estimate density values and create animal distribution maps for two case-study species—the Cuvier’s beaked whale and the fin whale. The project team

It is important to understand the difference between an animal hearing a sound and that sound causing an effect.



Cuvier's beaked whale.
 Gregory S. Schorr, NMFS permit 16111

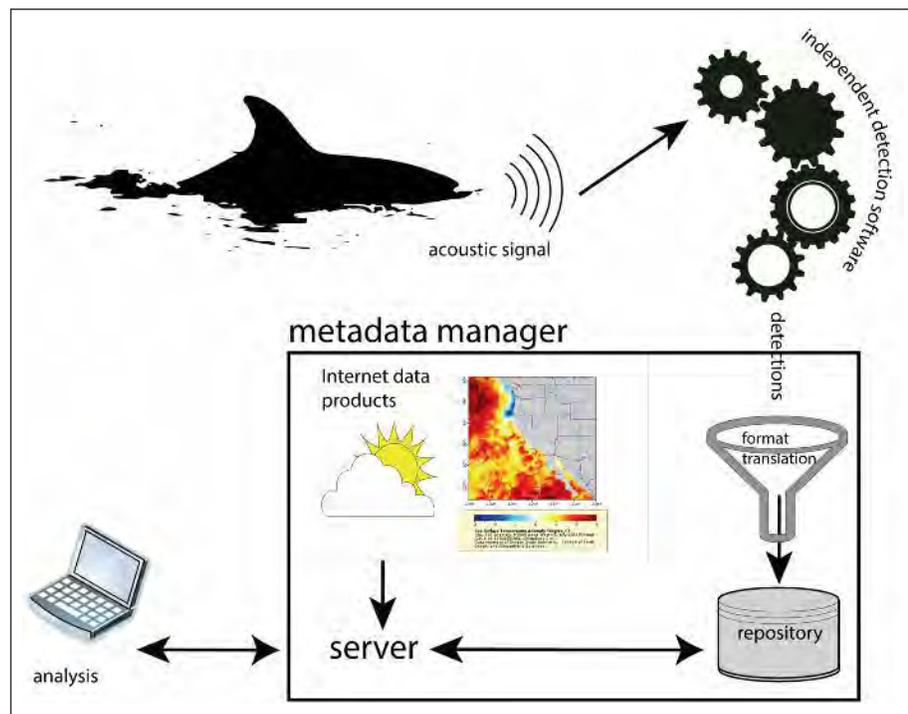
will leverage fin whale vocalization data obtained in the ongoing SOCAL-BRS. The project is heavily reliant on the Marine Mammal Monitoring on Ranges (M3R) PAM system developed for the instrumented Navy ranges by personnel from the Navy Undersea Warfare Center Newport, Rhode Island who are partners on this project.

The end products will be density estimates and associated animal distribution maps that combine data from both instrumented and non-instrumented ranges. Density estimates will be added to the Navy Marine Species Density Data archive.

NEED: Marine Species Monitoring Data Collection Toolkit Development

Current Navy-funded marine species surveys generate large quantities of data that often are collected using varying monitoring techniques. Data protocols, formats, standards, and

quality assurance and control procedures are items that need to be addressed in order to standardize data across the Navy's marine species monitoring program and ensure consistency with generally accepted standards within the scientific community.



Overview of workflow. Raw acoustic signals.
 NOAA Southwest Fisheries Science Center, Environmental Research Division

From 10 pre-proposals received, one was selected for FY15 LMR program funding and is now underway.

Acoustic Metadata Management for Navy Fleet Operations

Project number: LMR-15-18

Principal Investigator: Marie Roch, San Diego State University

This project will expand development of Tethys, a passive acoustic monitoring metadata database sponsored by National Oceanographic Partnership Program. Tethys incorporates the expertise of PAM personnel at NOAA Alaska, Northeast, Pacific Islands, Southeast, and Southwest Fisheries Science Centers as well as PAM experts at the Scripps Institution of Oceanography and San Diego State University. The system provides a standard that can be implemented on any system, and there is broad interest in transitioning what is

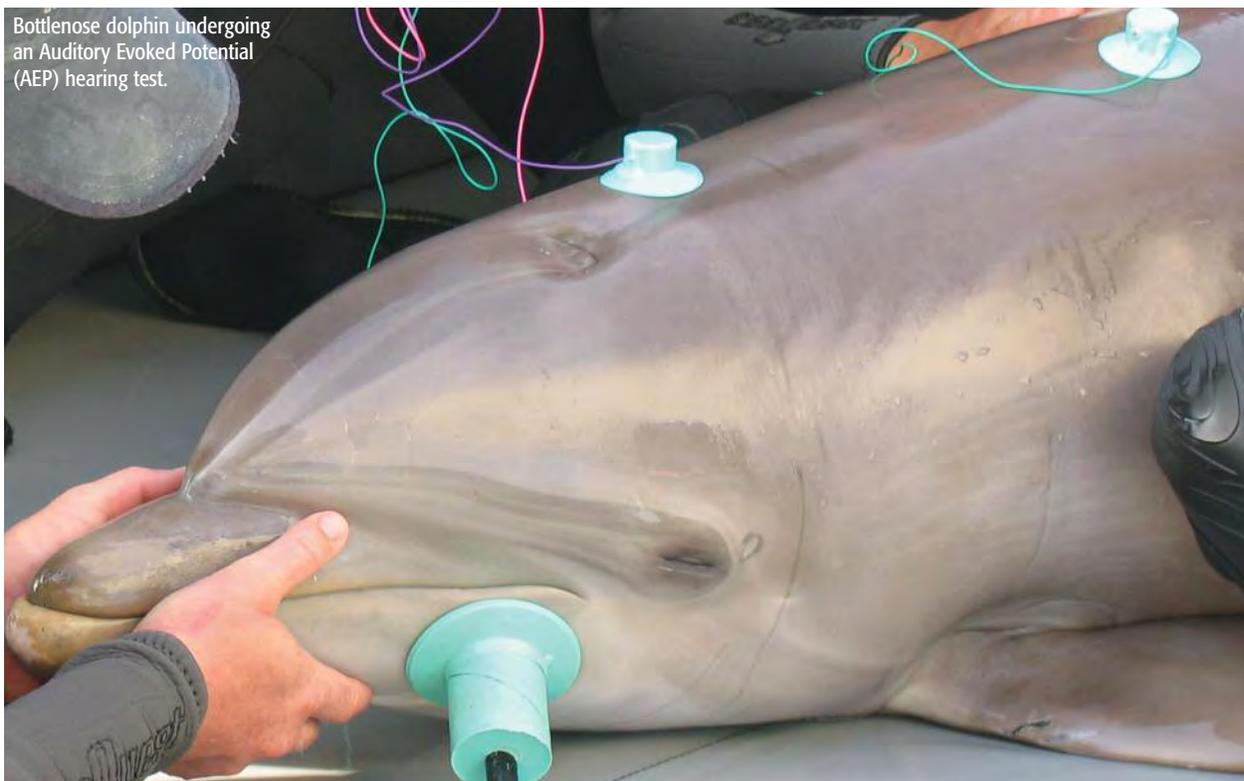
becoming a community standard into an official one.

The project team will strengthen the capabilities of Tethys to make it more usable by the Navy. Specific tasks include providing additional data analysis and reporting facilities, identifying bottlenecks in performance as the existing databases continue to grow in size, and further development of the program's schemata for localization. These efforts will improve its utility for long-term Navy monitoring data management and support Navy mitigation efforts.

The project is a collaborative effort among the Navy, NOAA, and BOEM. It builds upon work previously funded by ONR, and portions of the project are currently being funded by the LMR program while others are being funded by BOEM.

NEED: Hearing Measurements in a Broad Range of Marine Mammal Species

For the Navy to minimize the potential adverse effects resulting from exposure to sound, a fundamental need is a more complete understanding of how marine mammals hear and are affected by sound. There are multiple aspects of a sound source that might affect the hearing, behavior and physiology of marine mammals. Improved knowledge of these aspects will help in accurately estimating and predicting the audibility of frequency-related harmonics and other secondary features of sonar signals to different marine mammal species, and the distances at which such sounds can be detected. This information will support more appropriate mitigation measures to minimize the potential adverse effects resulting from exposure to complex anthropogenic sounds.



Bottlenose dolphin undergoing an Auditory Evoked Potential (AEP) hearing test.

Two Foundational LMR Projects

TWO OF THE earliest LMR projects are the Marine Mammal Monitoring on Ranges (M3R) project (no. LMR-12-01) and the Southern California Behavioral Response Study (SOCAL-BRS) (no. LMR-13-02). Several subsequent LMR projects draw from data and techniques developed through these two multi-year projects. Additional details follow.

Marine Mammal Monitoring on Ranges

M3R utilizes existing hydrophone (underwater microphone) arrays on Navy ranges to expand the Navy's knowledge about marine mammal presence, abundance and behavior. The data collected via the hydrophones is combined with other passive acoustic monitoring data, visual observation, biological sampling, and satellite tags. Marine mammal vocalizations are detected on individual hydrophones as an animal or group of animals moves across the range.

The goals of the M3R program are to:

- Develop automated passive acoustic marine mammal detection, localization, classification and display tools using existing Navy undersea hydrophone arrays and integrate visual and satellite monitoring methods to leverage the combination of the methods to study marine mammals on Navy ranges.
- Study and measure animal responses to Navy activities, including mid-frequency active sonar (MFAS), with a focus on beaked whales.
- Provide scientifically defensible behavioral response metrics for sensitive species like beaked whales, which can be used to inform regulatory risk criteria and provide insight into the cumulative effect of repeated sonar exposure.
- Provide baseline population density, abundance, and habitat usage data for Navy risk analyses and permit applications covering training and testing activities on the ranges.

M3R was initiated in 2000 by the Office of Naval Research (ONR). Core components of M3R program development were transitioned from ONR to LMR in 2009. Since then, prototype technologies have been extended and used to study animals on the ranges. M3R now is transitioning its monitoring and analysis tools so that they might be run and maintained by Navy range personnel. During FY15, the project completed significant system updates at three Navy ranges, improved system stability and upgraded hardware, installed packet recorders to archive raw acoustic data, and completed a user's manual.

Southern California Behavioral Response Study

SOCAL-BRS is designed to increase understanding of marine mammal reactions to sound and provide a more robust scientific basis for estimating the effect of Navy MFAS on marine mammal behavior.

The project began in 2010 and completed its most recent field season in 2015. The overarching approach has included a number of research objectives:

- Tag a variety of species and obtain baseline behavioral data.
- Conduct Controlled Exposure Experiments (CEE) to obtain high-resolution measurements of behavioral responses of marine mammals.
- Apply adaptive team configuration to support both simulated MFAS sources and actual military MFAS sources.
- Obtain basic biological, behavioral, and foraging ecology data for marine mammals to support range monitoring efforts and/or habitat models.

SOCAL-BRS is providing the Navy with baseline data on movement and acoustic behavior of a variety of cetacean species as well as individual high-resolution measurements of behavioral changes during exposure. To date that has included baseline and CEE data on more than 160 individuals of ten federally protected marine mammals, including two beaked whale species and four endangered species (blue, fin, humpback, and sperm whales). All of these data represent novel measurements for these species. Measurements are providing quantitative insights into the critical importance of exposure context (e.g., distance from source, depth, behavioral state at time of exposure, etc.) in terms of the probability and type of behavioral response.



Sperm whale.

Data from this study will more than double the number of individual killer whales that have been tested, as well as provide hearing data over a large age range of 12 to 49 years.

From 29 pre-proposals received, four were selected for FY15 funding and are now underway.

Standardization of Auditory Evoked Potentials (AEP) Audiometry Methods to Ensure Comparable Data Inclusion in a National Marine Mammal AEP Database

Project number: 13

Principal Investigator: Dorian Houser, National Marine Mammal Foundation

To understand the natural or baseline hearing in marine mammals, researchers have measured hearing thresholds either by studying behavioral response to sound or by taking an electrophysiological approach. In the latter, they measure voltages produced by the brain in response to an acoustic stimulus. These voltages (AEPs) can be quickly measured in subjects with minimal subject cooperation.

However, different AEP methodologies can result in large differences in threshold estimates for the same species, or even the same individual. Differences may vary on the order of tens of decibels, which has serious ramifications for determining the range of audibility for Navy acoustic sources, as well as for estimating impacts

within mid- to low-frequency ranges where variances will be the greatest.

This project standardizes hearing threshold measurement methods used in toothed whales (odontocetes) and increases species representation and sample sizes in hearing threshold estimates to reduce uncertainty in hearing range analyses used by Navy planners. Efforts include developing and promoting a standardized methodology for the collection and reporting of audiometric information from odontocetes through AEP methods. Following completion of the standard, the portable AEP system currently in use, called the Evoked Response Study Tool (EVREST), will need to be reprogrammed according to the consensus methodologies determined through the standardization process.

Data collected from wild odontocetes with the AEP systems, under standardized methods, will be incorporated into the national AEP database and access for queries to the database will be made available to Navy environmental planners.

Behavioral Audiometry in Multiple Killer Whales

Project number: 14

Principal Investigator: Brian Branstetter, National Marine Mammal Foundation

This project provides the first demographic hearing data from killer whales by measuring behavioral audiograms from five to eight participants that vary in age and gender. Additional subjects may become available during the course of the study. Audiograms will be measured using well-established psychoacoustic methods that are regularly employed by the National Marine Mammal Foundation for the testing of hearing in dolphins. Psychophysical hearing tests are the “gold standard” of hearing tests, leading to the most accurate audiometric measurements.



A killer whale positioned on a stationing device while participating in a psychophysical hearing test.

This modeling environment gives researchers the ability to conduct “virtual experiments” to investigate basic mechanisms of hearing and sound production.

Data from this study will more than double the number of individual killer whales that have been tested, as well as provide hearing data over a large age range of 12 to 49 years. This will help to determine accurate mid-frequency cetacean composite audiograms and weighting functions for Navy at-sea environmental compliance. This work is follow-up to a 2014 cooperative project between Sea World San Antonio and U.S. Fleet Forces Command.

Jawphone Simulations to Maximize the Utility of Psychoacoustic and Auditory Evoked Potential Experiments

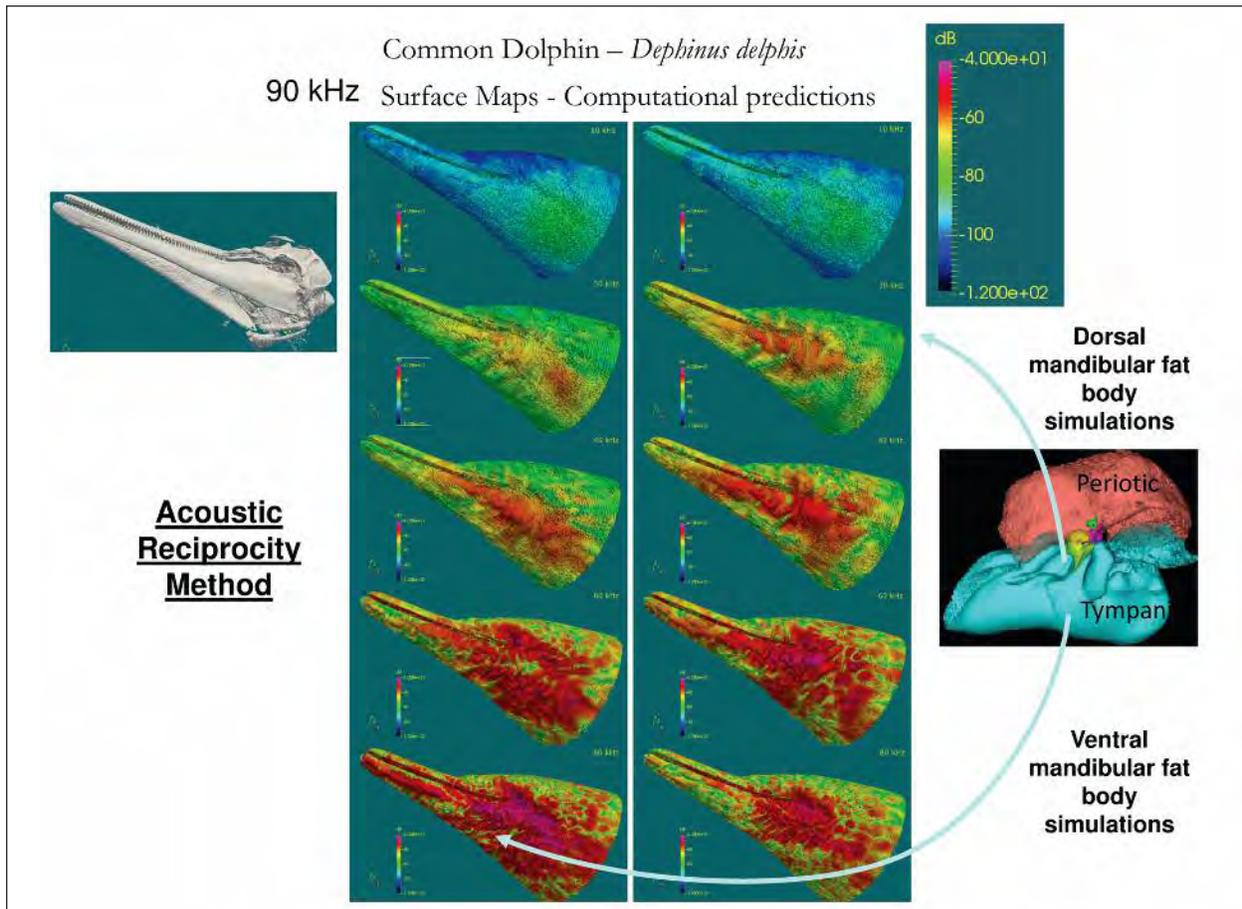
Project number: 15

Principal Investigators: Ted Cranford, San Diego State University; Petr Krysl, University of California, San Diego

Auditory evoked potential can be quickly measured in subjects with minimal subject cooperation. To date, however, basic hearing measures

(AEP or behavioral) have only been compiled on a small number of animals, and interpreting AEP results may be more complicated when a device called a jawphone (suction cup containing a transducer) is used. The placement, frequency selection, and other parameters of the jawphone can affect AEP testing results.

In preliminary simulation studies, it appears that jawphones can selectively excite hearing pathways that



Common dolphin surface maps.



Harbor porpoise at listening station.
Dominic Dijkstra

may be different from those used naturally by the animals. Small changes in the placement of a simulated jawphone can cause large amplitude differences (several decibels) by the time the sounds reach the ears.

This project uses a computational approach to identify the mechanism(s) by which jawphones stimulate hearing when they are used to gather data on marine mammal auditory capabilities. The methodology is based on finite element modeling techniques, where high-resolution computerized tomography scan data are combined with measurements of tissue properties and custom-built computer programs to simulate sound propagation into and out of the anatomic complexity of specimens. Model outputs will quantify the acoustic pathways between the jawphone and the ear, which will enable researchers to compile sensitivity maps that identify the optimal locations for jawphone placement in three dolphin species. These maps can be used to design and evaluate AEP-based hearing tests, guiding jawphone placement to minimize errors due to variable response sensitivity to the location of the transducer on the animal's skin.

This modeling environment gives researchers the ability to conduct “virtual experiments” to investigate basic mechanisms of hearing and sound production, and to simulate exposure levels at sound pressures that would be impossible or unethical with live animals. These

results will be helpful in the design and evaluation of past and future AEP hearing tests, will significantly reduce lifecycle costs of physical experimentation, and have the potential to reduce environmental impacts.

Behavioral Dose-Response Relationship and Temporary Threshold Shift in Harbor Porpoises

Project number: 20

Principal Investigator: Ron Kastelein, Sea Mammal Research Company Inc.

A variety of Navy sonar sources are audible to harbor porpoises (*Phocoena phocoena*), a small odontocete species that has a wide distribution area, acute hearing, and functional hearing over a very wide frequency range.

It is important to understand the difference between an animal hearing a sound and that sound causing an effect—either a behavioral effect or a physiological effect on hearing, known as a temporary threshold shift (TTS) or permanent threshold shift. Based on the presently available information, neither TTS (especially for frequencies above 7 kilohertz (kHz)) nor behavioral responses can be predicted for harbor porpoises due to exposure to specific signals of U.S. Navy relevance.

This project consists of two study types: a behavioral dose-response study and a TTS study. The behavioral dose-response study consists of two phases:

The Basics About the LMR Program

THE LMR PROGRAM seeks to develop, demonstrate, and assess data and technology solutions to protect living marine resources by minimizing the environmental risks of Navy at-sea training and testing activities while preserving core Navy readiness capabilities. This mission is accomplished through the following five primary focus areas:

1. Providing science-based information to support Navy environmental effects assessments for at-sea training and testing.
2. Improving knowledge of the ecology and population dynamics of marine species of concern.
3. Developing the scientific basis for the criteria and thresholds to measure the biological effects of Navy-generated sound.
4. Improving understanding of underwater sound and sound field characterization unique to assessing the biological consequences of underwater sound (as opposed to tactical applications of underwater sound or propagation loss modeling for military communications or tactical applications).
5. Developing technologies and methods to mitigate and monitor environmental consequences to living marine resources resulting from naval activities on at-sea training and testing ranges.

The program is sponsored by OPNAV N45 and managed by the Naval Facilities Engineering Command out of the Naval Facilities Engineering and Expeditionary Warfare Center in Port Hueneme, California.

For more information, visit the LMR program web site at www.lmr.navy.mil or contact Anu Kumar, the LMR Program Manager at 805-982-4853, DSN: 551-4853 or anurag.kumar@navy.mil.



1. Establishing the dose-behavioral response relationship for playbacks of 53-C sonar sounds at two duty cycles (2.6 and 90 percent) in quiet conditions.
2. Establishing the dose-behavioral response relationship for playbacks of 53-C sonar sounds at 2.6 percent duty cycle in three Sea State noise conditions (Sea States 0, 4 and 6).

The TTS study also consists of two phases:

1. Establishing which hearing frequency is most affected by several continuous pure tones above 8 kHz (i.e., shows the highest TTS).
2. Establishing TTS growth curves (due to sound pressure level) for

each of the tested frequencies (1 hour exposures).

The results of the behavioral dose-response and TTS studies will be used to update the criteria and thresholds for harbor porpoises that are used to estimate potential exposures from Navy training and testing activities.

Refining Knowledge Supports Improved Understanding & Protection

Each of the FY15 new start projects will help the Navy refine its knowledge of how marine mammals might be affected by anthropogenic sounds. Improved data collection, management and analysis are all critical to the permitting process for Navy at-sea

operations. Increasing the understanding of how marine mammals hear will inform the Navy about potential effects of different sound sources. With this information, the Navy can employ better monitoring and mitigation techniques.

The LMR program continues to help the Navy meet its training requirements while protecting the species with whom they share the oceans. Fact sheets with more information on the FY15 projects can be found under the "Project Highlights" tab on the LMR web site at www.lmr.navy.mil. [↗](#)

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MCAS Cherry Point Implements Innovative Water Quality Monitoring System

System Reduces NPDES Manpower Requirements, Provides Real-Time Water Quality Data

MARINE CORPS AIR Station (MCAS) Cherry Point's implementation of a state-of-the-art stormwater monitoring system reduces the manpower requirements associated with their National Pollutant Discharge Elimination System (NPDES) stormwater permit and provides real-time water quality data to air station personnel.

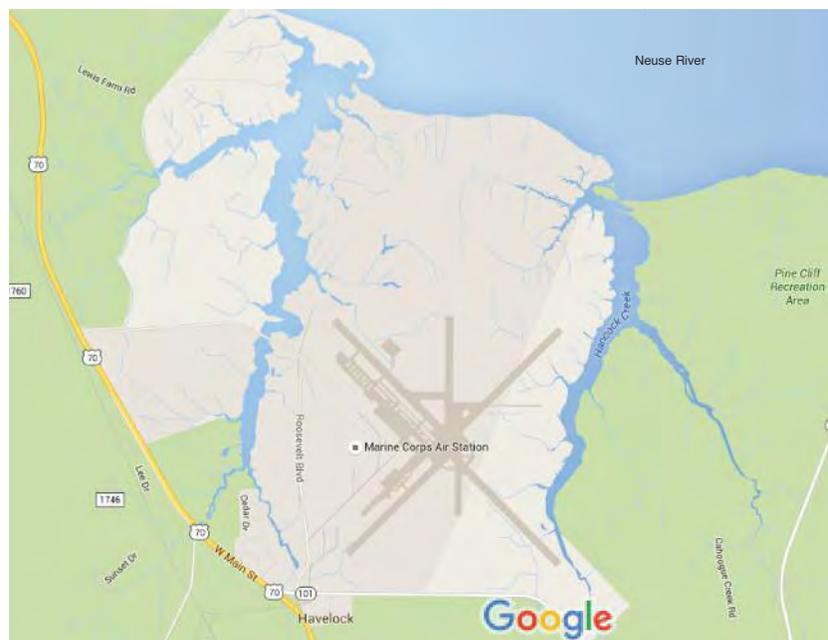
Introduction

Stormwater drainage system infrastructure at MCAS Cherry Point carries runoff from rain events to receiving streams within the nutrient-sensitive Neuse River Basin in eastern North Carolina. Water quality concerns with receiving waterbodies such as the Neuse River Estuary are associated with discharges from municipalities, agriculture, commercial/industrial sites, and other point and non-point sources of pollution along the water body.

The North Carolina Department of Environmental Quality (NCDEQ), formerly the North Carolina Department of Environmental and Natural Resources, has developed measures

to help eliminate sources of pollution to receiving waters such as the Neuse River, including implementing Surface Water Quality Standards via the issuance of NPDES stormwater permits, establishing water quality benchmarks for the Stormwater Permitting Program, and developing Total Maximum Daily Loads (TMDL) under Section 303 of the Clean Water

Act. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. A TMDL for total nitrogen has been established for the Neuse River Estuary; however, MCAS Cherry Point has not been named as a contributor and has not received load allocations for stormwater. Personnel from the



Marine Corps Air Station Cherry Point.
Map data ©2015 Google

The stormwater program manager uses the laptop to track data trends and monitor the water quality results at each outfall.

MCAS Cherry Point Environmental Affairs Department (EAD) have successfully implemented a real-time, automated water quality and flow monitoring system at five stormwater outfalls at the MCAS Cherry Point. In the event that the State of North Carolina names MCAS Cherry Point as a contributor for stormwater and the air station receives a load allocation, they will be well-equipped to comply.

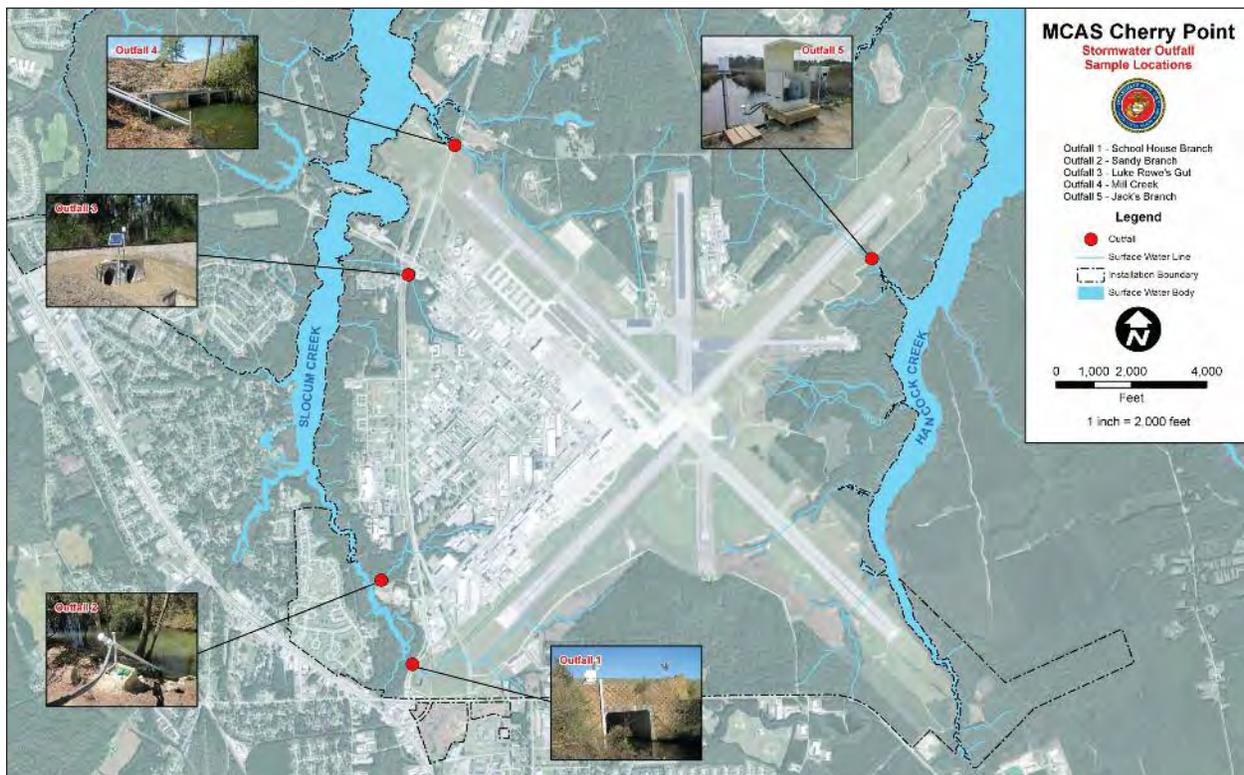
The environmental contracting team selected URS Group, Inc. (now AECOM) and its teaming partner YSI Integrated Systems and Services, Inc. (YSI) to install compliant and calibrated flow meters, automatic

samplers, and continuous water quality monitoring probes (also referred to as water quality sondes) at MCAS Cherry Point in 2013. The objective of the equipment installation project was to provide MCAS Cherry Point with the means to collect NPDES permit-required samples, continuously monitor seven additional water quality parameters, monitor the flow rate through the outfalls, and monitor rainfall at each of the following outfall sites.

- Outfall 1: Schoolhouse Branch
- Outfall 2: Sandy Branch
- Outfall 3: Luke Rowe's Gut

- Outfall 4: Mill Creek
- Outfall 5: Jack's Branch

A stand-alone laptop computer was configured to remotely connect to the monitoring systems allowing the EAD stormwater program manager to conveniently collect and analyze data without visiting each site regularly. The stormwater program manager uses the laptop to track data trends and monitor the water quality results at each outfall to stay on top of water quality issues associated with MCAS Cherry Point's industrial corridor. A case study from Outfall 1, Schoolhouse Branch, will be examined further in subsequent sections of this article.



Stormwater monitoring installation location overview.

Monitoring System Setup & Maintenance

Each of the five sites selected for monitoring receive flow from drainage basins associated with the industrial corridor of the base. The following equipment was installed at each outfall monitoring station:

- Multiparameter YSI EXO2 water quality probes with temperature, conductivity, salinity, pH, turbidity, total dissolved solids (TDS), and optical dissolved oxygen (DO) monitoring capability
- Site-specific SonTek IQ flow meters at four outfalls and a SonTek Argonaut SL-3000 flow meter at Outfall 2 (Sandy Branch)
- Portable ISCO 3700 multiple bottle autosamplers
- Tipping bucket rain gauges equipped with an 8-inch orifice and a mechanism to regulate measurement during intense downpours to improve accuracy
- Integrated datalogger/control systems utilizing CSI CR1000 data-

loggers to measure and record parameters, and to actuate the autosamplers based on predetermined trigger events

- Airlink Raven XT cellular modems and peripherals for remote 2-way communication and control
- Fiberglass enclosures to house batteries, electronics, and autosamplers
- 60-watt solar charging systems with 75-ampere hour batteries

The flow meters installed at each outfall were calibrated in the field by YSI as part of the installation. Measurements of the culverts were collected as part of the calibration effort and input into the SonTek IQ: Intelligent Flow program in order to complete the flow calculation formulas. In addition, the flow meters had an initial pressure calibration. The time period between calibrations is tracked and the user is prompted by the IQ program for subsequent calibrations.

Each monitoring system location is equipped with an ISCO 3700

multiple bottle autosampler. These portable units are programmed to collect NPDES-permit required water quality samples based on one of two triggers—preset readings from the flow meter or remotely by the stormwater program manager using the laptop and data relayed from the monitoring systems. The geographically separated outfalls make it challenging for EAD staff to collect NPDES permit-required water quality samples by hand and within the permit established timeframe. Use of the autosamplers allows EAD staff to focus their effort on performing field measurements for pH and temperature readings and retrieving the samples for preparation and shipment to a contracted laboratory for analysis. MCAS Cherry Point's NPDES permit-required analytical parameters and measurements include the following:

- Acute Toxicity
- Ammonia (NH₃ as N)
- Arsenic (total)
- Biochemical Oxygen Demand

Sandy Branch Outfall

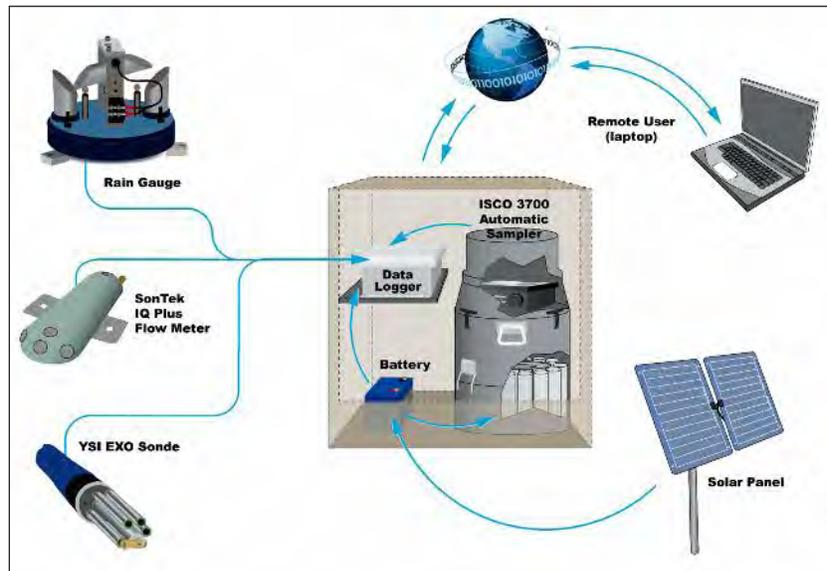
OUTFALL 2 (SANDY BRANCH) is an open channel, as opposed to culverts or pipes similar to the other outfalls. The flow meter that was installed at this location (SonTek Argonaut SL-3000) projects beams across the open channel to calculate flow rates. Due to the site location and determination that the channel for Outfall 2 was an irregular shape, an open channel survey was performed to determine the parameters for flow calculations. The river surveying unit shown in the figure at right was deployed at the outfall location to verify stream dimensions and flow data.

The river surveying unit measuring the Sandy Branch outfall stream dimensions.



- Cadmium (total)
- Chemical Oxygen Demand
- Chromium (total)
- Conductivity
- Cyanide
- Ethylene Glycol
- Event Duration
- Fecal Coliform
- Fluoride
- Lead (total)
- Methylene Blue Active Substances (Detergents)
- Naphthalene
- Nickel (total)
- Nitrate + Nitrite
- Oil and Grease
- Pesticides
- pH
- Silver (total)
- Total Kjeldahl Nitrogen
- Total Flow
- Total Organic Carbon
- Total Rainfall
- Total Suspended Solids (TSS)

The data collected via the integrated datalogger/control system is transferred to the stand-alone laptop by cellular data communications utilizing the Airlink Raven CT cellular modem and associated peripherals (i.e., antennae). Communication between the water



Stormwater monitoring system configuration.

quality monitoring equipment, autosampler, datalogger, and the laptop is illustrated in the figure above.

The CSI CR1000 datalogger is the main device controlling the stormwater monitoring system at each of the five outfalls. The datalogger records measurements from each sensor, stores the data, directs sampling during events, and sends out alerts via email. A custom CRBasic program that runs inside the datalogger and defines its operation was developed by YSI and implemented at each monitoring system. The program can be viewed and modified using LoggerNet software, which has been installed on the stand-alone laptop. Rain gauge, water quality, and flow meter parameters are measured at specific intervals controlled by the datalogger.

Rain gauge parameters are accumulated in 15-minute increments and

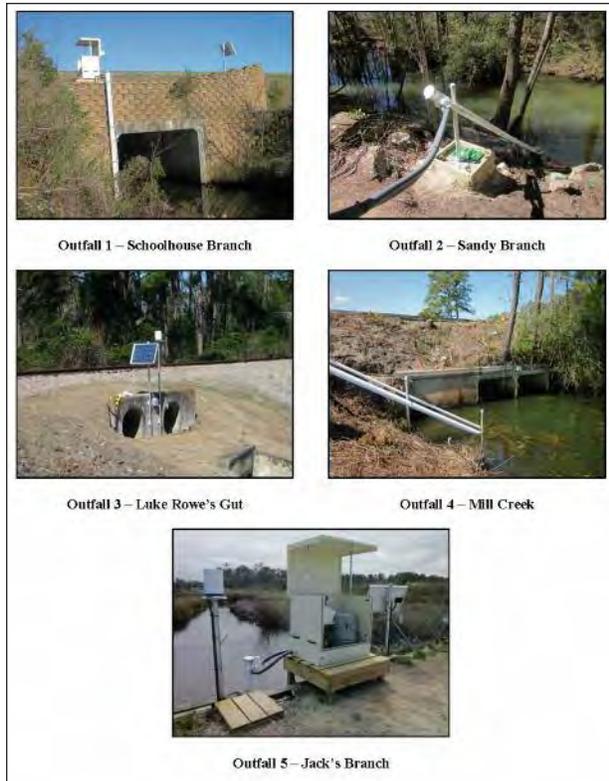
reported to the datalogger when queried. Water quality parameters from the EXO2 probe are also logged internally in 15-minute increments. When queried by the datalogger, the EXO2 probe transfers the recorded data to the datalogger. Flow is measured and stored with the SonTek flow meter in five-minute intervals. In addition to water quality parameters, the systems also record diagnostic data (i.e., battery voltage, datalogger temperature, and current set points) on an hourly basis.

During a rain event, specific event data such as flow, samples taken, discharge volume since the last sample, and the time since the start of the event are stored in five-minute intervals for the duration of an event. These data are particularly important with regards to compliance with MCAS Cherry Point's stormwater NPDES permit. As part of the required sampling, the air station must report the total flow and event

As part of the required sampling, the air station must report the total flow and event duration on its discharge monitoring report.

duration on its discharge monitoring report (DMR) that accompanies the annual report submitted for each permit year. These systems allow for these data to be easily captured and reported to NCDEQ for permit compliance. The five monitoring system installation configurations are shown in the figure below.

The monitoring systems require regular operation and maintenance (O&M) to remain functional and continue to



Monitoring system installation areas.

Representative Storm Event

A REPRESENTATIVE STORM event is defined as an event with total rainfall that measures greater than 0.1 inches. To qualify as a representative storm event that MCAS Cherry Point can utilize for required sampling and NPDES Permit Report purposes, the time between the current storm event and the previous storm event measuring greater than 0.1 inches must be at least 72 hours. In addition, a single storm event may have a period of no precipitation of up to 10 hours. For example, if the rain stops before producing any collectable discharge, a sample may be collected if the next rain producing a discharge begins within 10 hours.

collect water quality and flow data and stormwater samples remotely. Monthly O&M includes calibration of the EXO2 probe, inspection and cleaning of the rain gauge, datalogger inspection (e.g., desiccant inspection and regeneration based on moisture collection), and removal of debris from the flow meter. AECOM and YSI have assisted MCAS Cherry Point with major annual maintenance at each outfall since installation.

Water Quality Event Notification, Data Review & Trend Analysis

The stand-alone laptop is designed to function as the base station for the monitoring systems. The data recorded at each site are automatically collected and stored by the base station via the LoggerNet software while the modem is active and LoggerNet is running. The alerts sent from the sites run independently of the laptop data collection and are sent regardless of whether the laptop is running.

The stormwater program manager is able to identify representative storm events using the rain gauge and flow meter measurements at the outfalls thus providing information needed to trigger sampling. The CRBasic program queries the flow meters every five minutes to enable quick event detection; with the goal to capture the first water sample within 30 minutes of the beginning of an event. Once a representative storm event is verified, the stormwater program manager is notified via email.

In addition to data collection, the LoggerNet software allows the stormwater program manager to complete the following tasks:

- Plot historical data for analysis
- View the latest data at a site remotely
- Adjust certain variables related to the event trigger
- Remotely activate the autosampler

The water quality monitoring systems have been in use since April 2013. Data collected using these systems are analyzed for trends by the stormwater program manager.

Case Study: Outfall 1 (Schoolhouse Branch) Water Quality Monitoring & Data Analysis

The drainage basin associated with Outfall 1, Schoolhouse Branch, has a total area of approximately 646 acres. Typical activities that are performed in the

drainage basin include industrial activities (e.g., aircraft and vehicle maintenance) as well as open areas and general flight line activities, such as take-offs and landings.

North Carolina receives rainfall throughout the year allowing for many potential storm events, both representative and non-representative, that can be used for examining the time-series based on the data that each of the water quality monitoring systems collects. Below is a discussion of trend analysis during a 1.61-inch rain event on March 7, 2014 at Outfall 1 (Schoolhouse Branch). Rainfall data relayed from the KNKT weather station located on the MCAS Cherry Point flightline, and obtained from www.wunderground.com, show that rainfall peaked between 4 a.m.

and 5 p.m. with an hourly rainfall accumulation of 0.30 inches, followed by continuous rainfall until approximately 7 a.m. Light rain continued at irregular intervals throughout the remainder of the day. A snapshot of the hourly rainfall accrual for the beginning hours of the storm event is presented in the table below.



Stormwater Outfall 1: Schoolhouse Branch
stormwater monitoring system overview.

Comparing the precipitation history for March 7, 2014, as shown in the table below and the precipitation chart included in the figure on the following page, to the flow rates at Outfall 1, also shown in the same figure, there is a correlation to the elevated flow rates. The precipitation peaks at approximately 5 a.m., with the flow at the outfall

MCAS CHERRY POINT HOURLY WEATHER HISTORY (MARCH 7, 2014)

Time (EST)	Temperature	Precipitation	Events	Conditions
12:54 a.m.	48.9 °F	0.09 inches	Rain	Rain
1:54 a.m.	50.0 °F	0.15 inches	Rain	Rain
2:54 a.m.	50.0 °F	0.20 inches	Rain	Rain
3:54 a.m.	50.0 °F	0.20 inches	Rain	Rain
4:54 a.m.	50.0 °F	0.30 inches	Rain	Heavy Rain
5:54 a.m.	46.9 °F	0.28 inches	Rain	Heavy Rain
6:47 a.m.	46.9 °F	0.12 inches	Rain	Light Rain
6:54 a.m.	46.9 °F	0.12 inches	Rain	Light Rain
7:42 a.m.	48.9 °F	0.00 inches	None	Overcast
7:54 a.m.	50.0 °F	0.00 inches	None	Overcast
8:54 a.m.	52.0 °F	N/A	None	Overcast
9:54 a.m.	52.0 °F	N/A	None	Overcast
10:54 a.m.	52.0 °F	0.01 inches	Rain	Light Rain
11:34 a.m.	52.0 °F	0.03 inches	Rain	Light Rain
11:54 a.m.	52.0 °F	0.04 inches	Rain	Light Rain
12:54 p.m.	52.0 °F	0.02 inches	Rain	Light Rain
1:54 p.m.	50.0 °F	0.02 inches	Rain	Light Rain
2:01 p.m.	50.0 °F	0.00 inches	Rain	Light Rain
2:54 p.m.	46.9 °F	0.01 inches	Rain	Light Rain

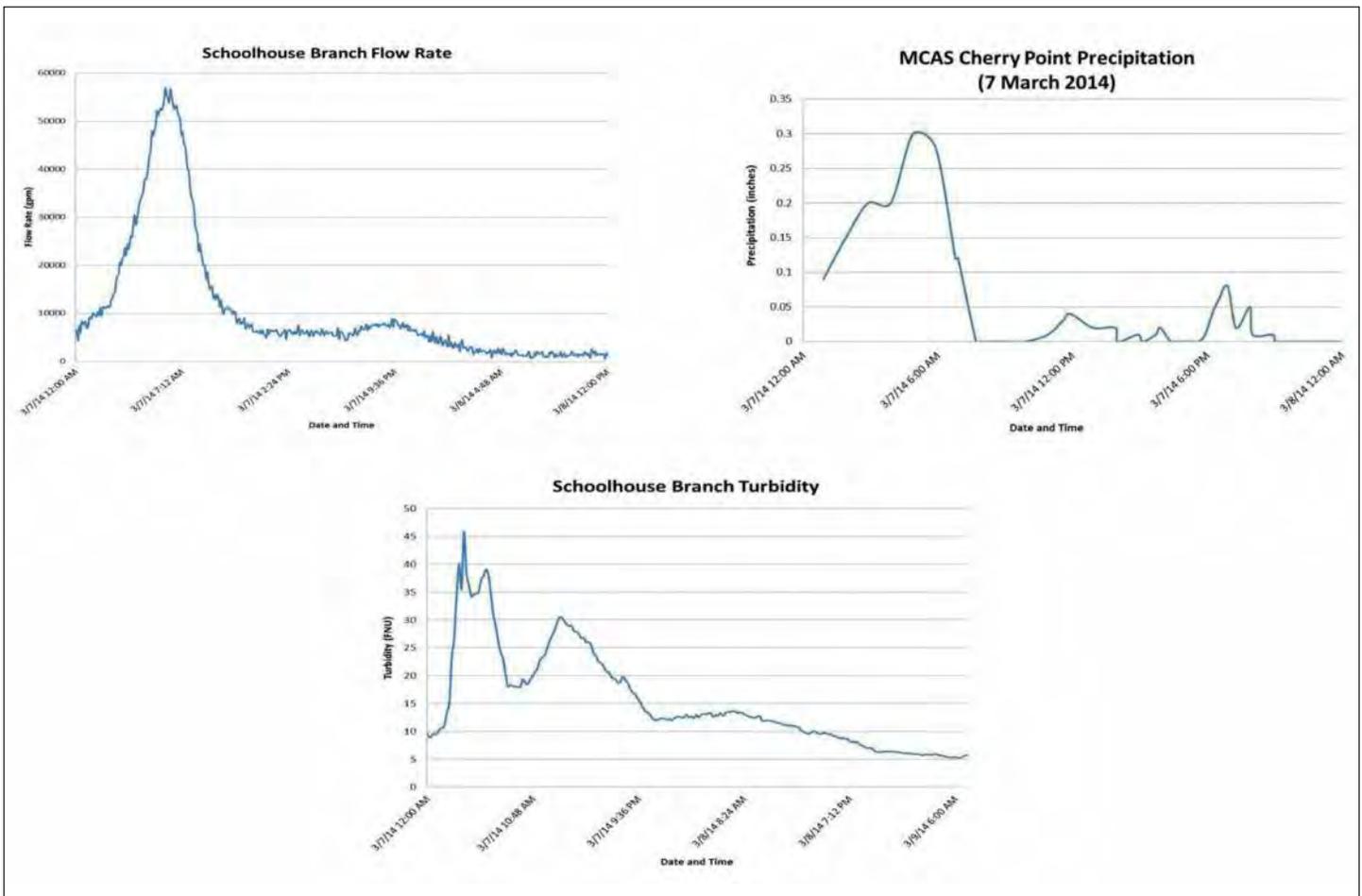
peaking at approximately 6 a.m. The delay in peaks can be expected as the stormwater runoff throughout the drainage basin makes its way through the conveyance system prior to being discharged at the outfall.

When evaluating stormwater quality data, turbidity can be directly related to flow. Turbidity, as defined by the U.S. Environmental Protection Agency (EPA), is a measure of water clarity based on how much the material suspended in water decreases the passage of light through the water. When the turbidity measurements plotted in the figure below are compared to the corresponding flow rates associated with the rain event,

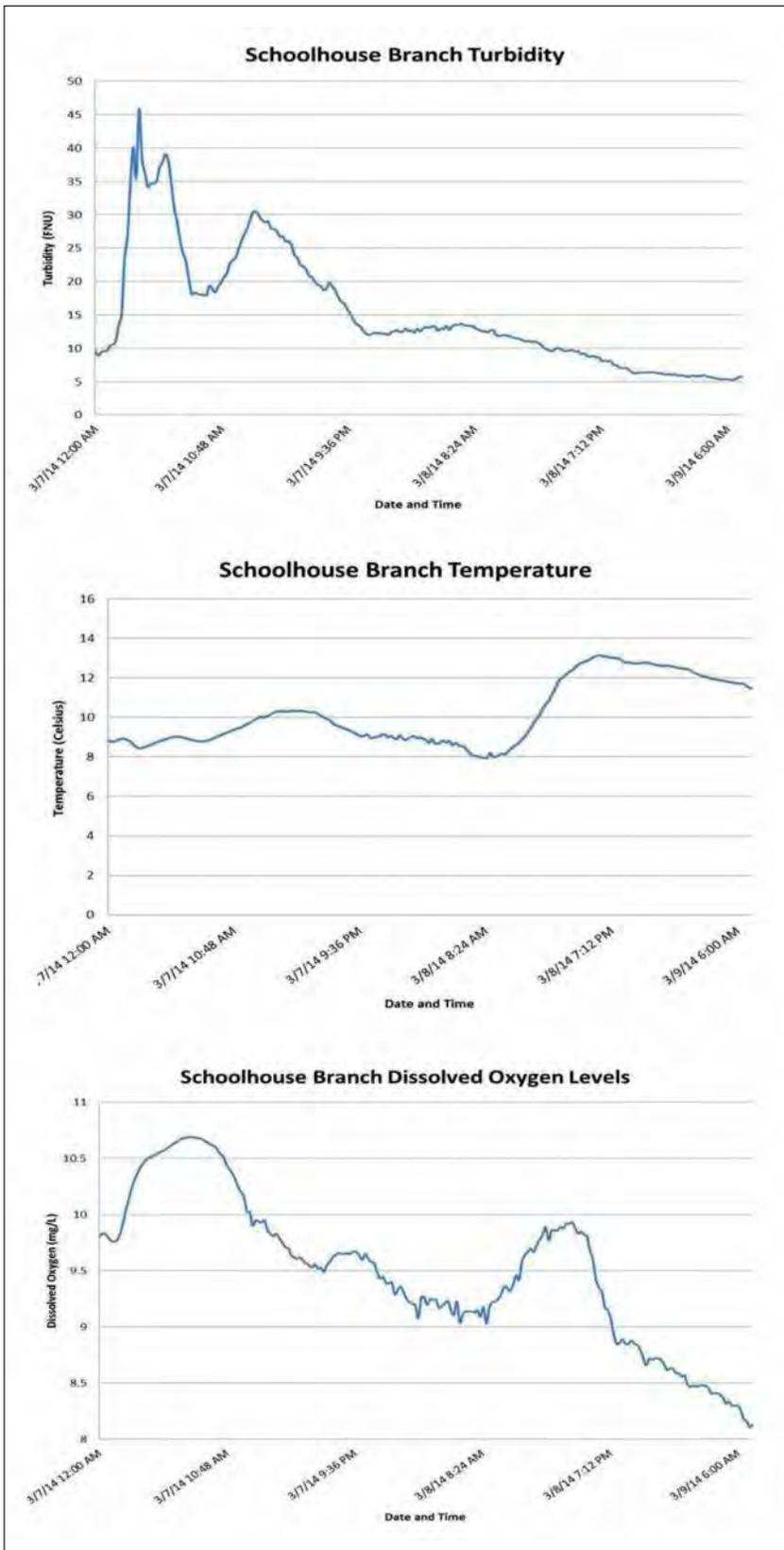
there is a direct correlation between the increase in flows during the rainfall event and the increase in turbidity of the water at the outfall. There is a delay in the increase of turbidity levels compared to the rainfall amounts and flow at the outfall; however, the increases and decrease follows the approximate trajectory with peaks and valleys of the rain event. Further review indicates that the turbidity levels take longer to subside after the rain event has passed. It is expected that as the flows increase at the outfall, the turbidity would increase due to the higher flows causing increased agitation of the channel bed, resulting in increased erosion. Furthermore, the

extended time for turbidity levels to return to normal can be expected as particles slowly settle out.

While the correlation of turbidity to flow rates and precipitation are discernible, additional correlation between turbidity and the other water quality parameters may also be analyzed as shown in the figure below. High turbidity levels at outfalls can increase the water temperature due to the suspended particles absorbing more heat. The increased temperature can further result in the reduction of DO levels because warmer waters hold less DO than cooler waters. As shown in the figure above, there is a delay between the increase in turbidity



Flow rate, precipitation and turbidity comparison.



Dissolved oxygen, temperature and turbidity comparison.

and the increase in temperature, which can be attributed to the long duration of the rain event and the cloud cover. In addition, the average temperature for March 7, 2014 was 46.4 degrees Fahrenheit, which can be considered a limiting factor in the ability of the water temperature to increase.

Conclusions

The water quality monitoring systems have been operating at the five outfalls along the industrial corridor of MCAS Cherry Point for approximately two and a half years. The ability to track the flow rates and precipitation at these locations have made it easier for MCAS Cherry Point to maintain compliance with their stormwater NPDES permit sampling requirements and to track water quality parameters at these locations. The stormwater program manager can now monitor the outfalls remotely and trigger sampling without having to be at the outfall. This allows for the samples to be collected within the 30-minute time period after the beginning of an event. The added efficiency can also allow the stormwater program manager to devote additional time to other areas of the program.

In addition, the monitoring systems provide EAD with real-time water quality data that can be used to identify potential impacts to the streams on MCAS Cherry Point (e.g., low DO levels that may affect aquatic life). These data can help MCAS Cherry Point target locations on the air station that can benefit from new best management practice implementation. In the event that the State of North Carolina develops TMDLs for the Neuse River Estuary and MCAS Cherry Point receives a load allocation, the air station will be well-equipped to demonstrate whether or not it is a contributor of the targeted pollutant(s). [↴](#)

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SSC Pacific Scientists Study Marine Mammals to Build a Better Sonar

New Research Focuses on How Sounds are Processed

ALTHOUGH SYNTHETIC UNDERWATER sensors have improved in target detection over the last two decades, dolphins still outperform them when it comes to mine detection and classification. A project led by bio-acoustic research scientist Dr. James Finneran at the Space and Naval Warfare Systems Center (SSC) Pacific is attempting to rectify this by improving our understanding of dolphin auditory physiology.

Dolphins utilize echolocation, a high-frequency, natural sonar system, to detect and classify targets in “noisy” environments. In the ocean, this translates to near-shore environments, where there is a high level of ambient noise from ships and from wave action against piers and

Dolphins & the Navy

The U.S. Navy has been training dolphins to perform various tasks since the early 1960s. Researchers found that dolphins and sea lions are highly reliable, easily trainable animals that excelled at delivering objects to divers, performing underwater surveillance, and locating underwater targets such as mines. Though it may sound like dangerous work, mines are made so that they cannot be set off easily by wave action or marine animals touching or bumping into them. When a dolphin finds an underwater mine, it marks the location of the object so it can be avoided by Navy vessels or investigated by Navy divers.

The animal emits a series of sound pulses and compares each to its corresponding returning echo to determine location and identity of an object.

the shore. Put simply, the animal emits a series of sound pulses and compares each to its corresponding returning echo to determine location and identity of an object.

Attempts have been made to improve manmade sonar systems by emulating the dolphin’s transmit and receive signals, but these efforts have produced limited success with target recognition. Instead of simply mimicking the dolphin’s own signals, this project team is attempting to replicate the manner in which a dolphin forms mental representations of a target.

In the future, undersea mines will be hunted by Unmanned Undersea Vehicles (UUV). These vehicles are being developed to patrol for mines in areas where they are suspected to occur.

The performance of a UUV sensor is critically linked to its automatic target recognition (ATR) system. ATR systems use sonar and various image processing techniques to identify and classify unknown objects. While ATR systems have improved in recent years, dolphins still outperform them when it comes to correctly identifying underwater targets.

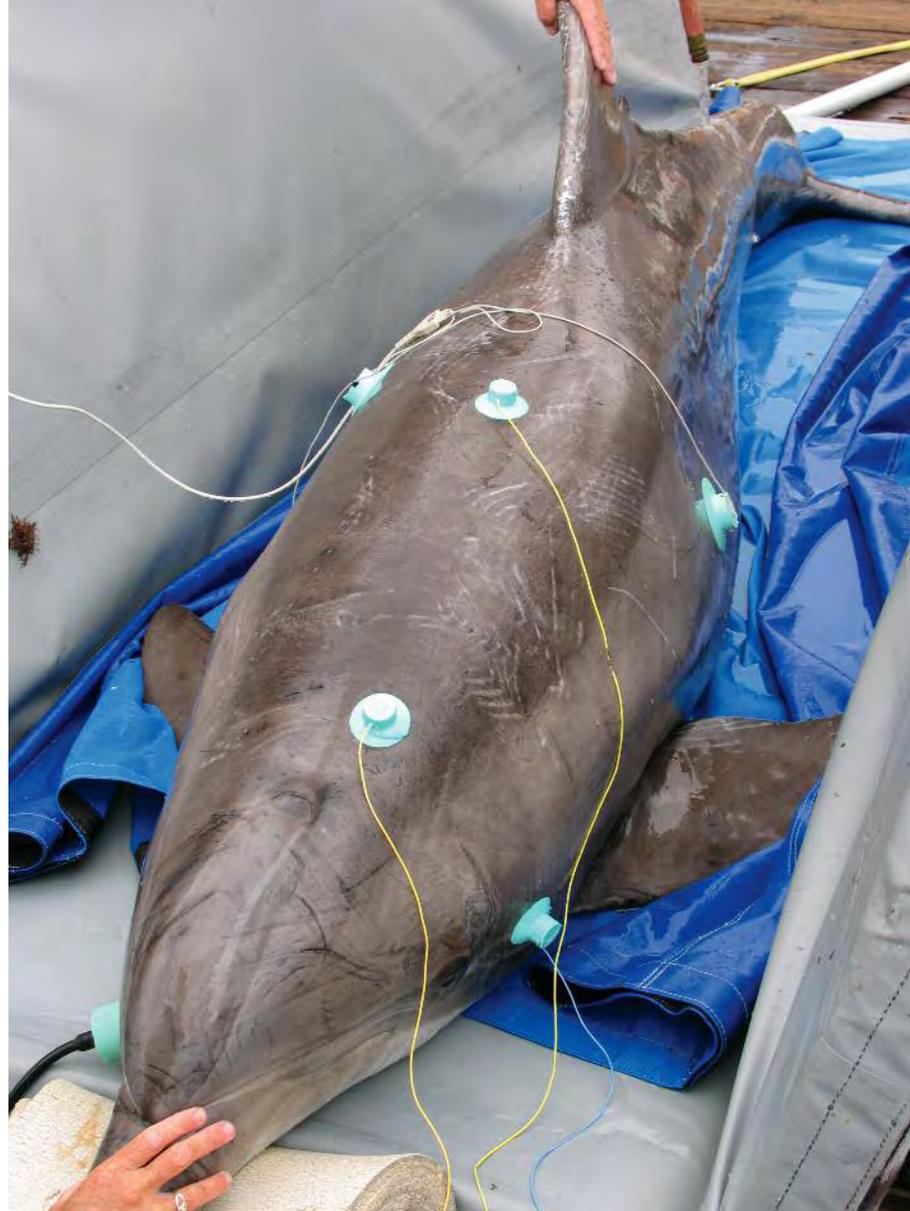
How Echolocation Works

Dolphins echolocate by emitting short-duration sound pulses (called “clicks”) and listening to the echoes that return from underwater objects. The time delay between the dolphin’s emitted click and its returning echo reveals the target range, while fine-scale differences between the click and echo reveal more specific details about a target’s shape and composition. As sound travels from a source it is naturally attenuated—this means that the echoes from underwater objects get smaller as the distance to the object increases. To help compensate for this natural change in echo strength with target range, dolphins have evolved several mechanisms, collectively referred to as “automatic gain control”—similar to the time-varying gain employed with hardware sonars. Based on dolphins’ performance in echoic discrimination tasks (reporting minute differences in returning echoes), it seems likely that they perceive the size and shape of targets in geometric terms.

In new research sponsored by the Office of Naval Research (Mine Countermeasures, Acoustics Phenomenology & Modeling Group), Dr. Finneran and his team are combining acoustical, psychophysical, and electrophysiological measurements to understand how dolphins form biological sonar (biosonar) representations. While previous research has been aimed at imitating the acoustic characteristics of dolphin echolocation clicks, this work is directed toward capturing a dolphin’s own mental representation of its emitted click patterns and echo delay responses and learning how this information is used by the dolphin to make decisions during echolocation tasks.

Three experiments will be conducted to increase understanding of the characteristics of biosonar representations formed by dolphins:

- Investigating the internal neural representation of the dolphin’s own emitted click.
- Determining the limits of echo-delay resolution.
- Examining the feasibility of a signal processing technique called “Independent Component Analysis (ICA)”



A dolphin rests on a foam mat and wears noninvasive surface electrodes during an AEP measurement. Having the dolphin out of the water makes the AEPs easier to measure and allows precise placement of the electrodes. For in-air measurements, jawphones are used to present the sound stimuli to the dolphins. Surface electrodes measure the brain’s responses.

Randall Dear

to isolate neural components associated with echoic signal processing.

Auditory Evoked Potentials

The first step will attempt to determine whether dolphins may have the same ability as bats to perceive objects in close proximity to each other. Many bats emit a Frequency Modulated (FM) signal, a broadband, tonal signal which enables them to hone in precisely on prey in cluttered environments. Dolphins emit very short-duration, broadband, impulsive sounds that are much different than the longer-duration echolocation sounds used by FM bats.

The performance of a UUV sensor is critically linked to its automatic target recognition system.

Dr. Finneran's team has much prior experience measuring the response of the dolphin auditory nervous system to sounds. This technique uses non-invasive surface electrodes to measure small voltages (called auditory evoked potentials (AEP)) generated by the brain and auditory nervous system when an animal hears a sound. In the current research effort, AEPs would be measured and used to determine the frequency content and timing of the dolphin's "self-heard" click at the level of the cochlea. While dolphins do not emit FM signals, frequency-

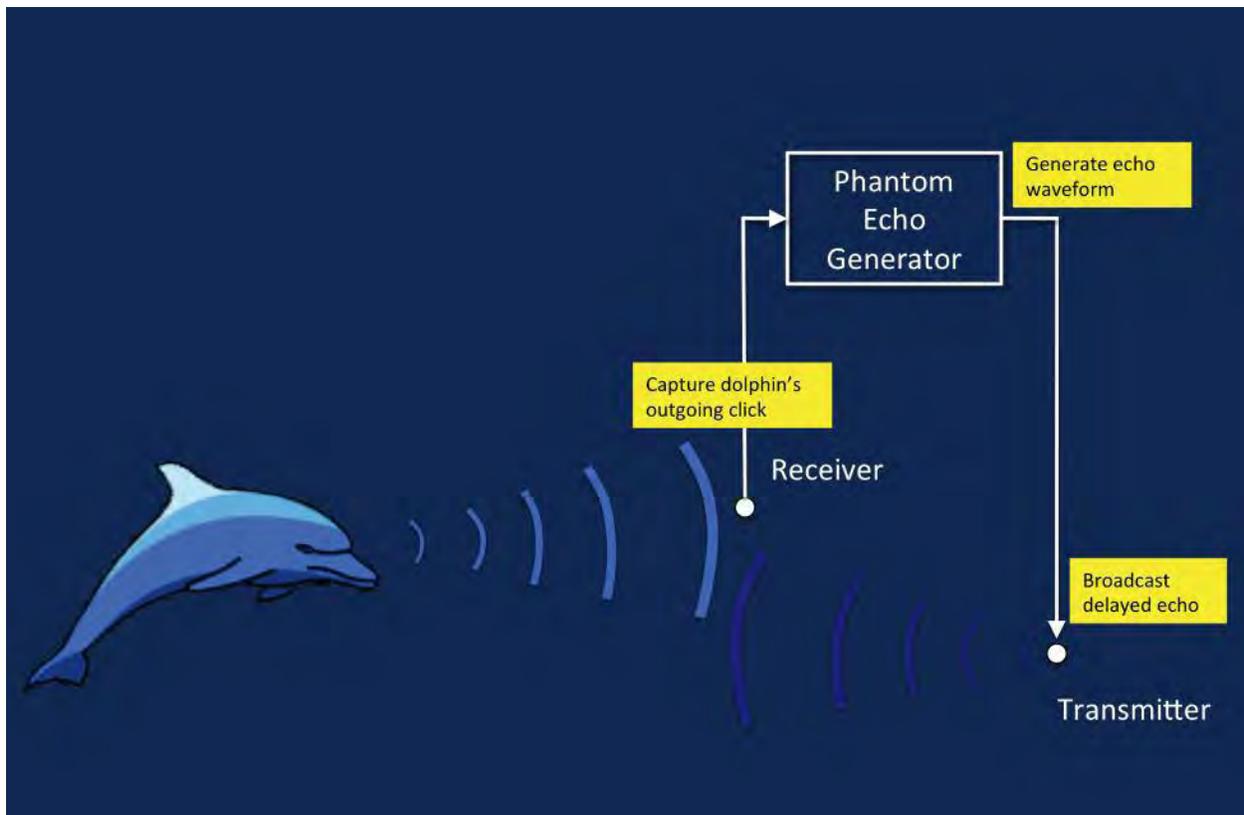
dependent time delays within the cochlea may effectively convert the neurological representations of clicks to FM signals. The AEP method will determine the FM nature of the dolphin's "self-heard" click, which in turn will give researchers an idea about how they might compare to the bat's echolocation process.

Phantom Echoes

Next, an experiment that mirrors a 1990 study with big brown bats will be undertaken. The bat study, headed by J.A. Simmons, utilized complex signals to determine how a bat deter-

mines distance to a target and the geometric features of the target.

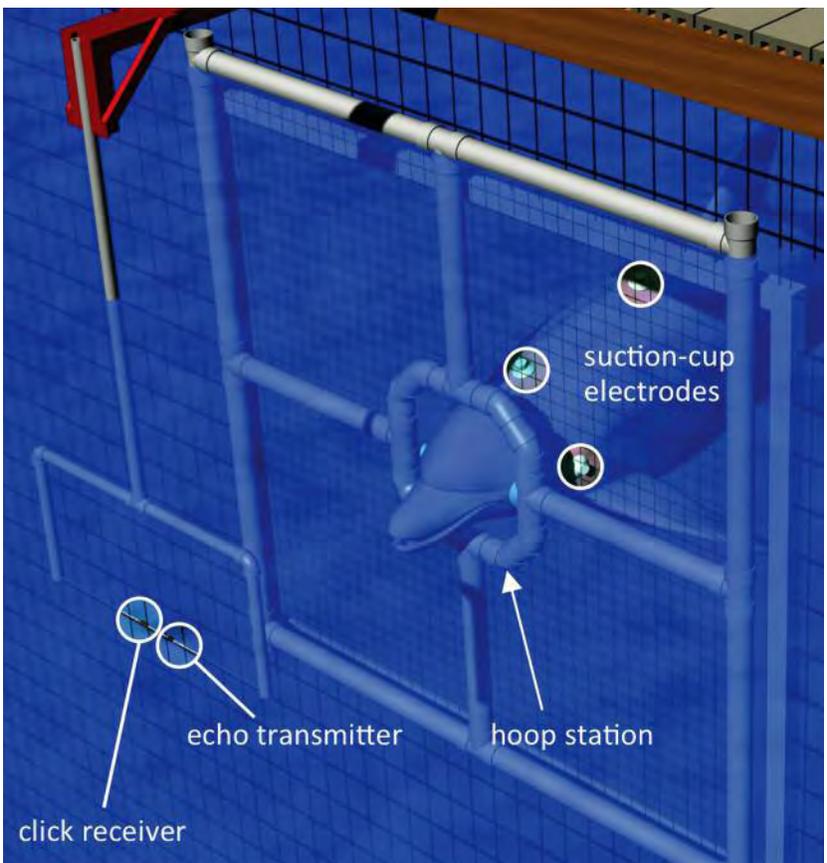
In this task, a phantom echo generator will be used to simulate echoes from physical targets. The phantom echo generator captures the dolphin's emitted echolocation pulse, creates an electronic echo waveform simulating the echo from a specific target, then broadcasts a delayed, scaled echo back to the dolphin using an underwater speaker. Echoes will be "jittered" or manipulated by alternating echo delays in an attempt to determine how fine the echo delay resolution is in dolphins. The amount



The phantom echo generator captures the dolphin's emitted echolocation pulse, creates an electronic echo waveform simulating the echo from a specific target, then broadcasts a delayed, scaled echo back to the dolphin using an underwater speaker.



A dolphin wears electrodes in preparation for an underwater AEP hearing test.
James Finneran



Schematic of a dolphin participating in a phantom echo detection task while wearing surface electrodes embedded in suction cups for AEP measurements. The hoop station ensures that the dolphin's position is consistent between trials relative to the sound projector and hydrophone.
James Finneran

of time by which the echoes are jittered would be varied to determine the animal's threshold for determining whether the echoes represent one object or multiple objects. This experiment is intended to determine just how detailed the mental representation is when the dolphin performs an echolocation task. If the animal is able to perceive two distinct, closely placed objects, it's an indication that the dolphin's mental resolution is very small (detailed).

Independent Component Analysis

Next, AEPs will be measured using a multi-electrode array while dolphins perform an echolocation task. The AEP data from the multi-electrode array will then be analyzed using the ICA signal processing technology. ICA technology separates a signal into individual components, which will help researchers identify the spatial locations in the dolphin's brain where various components of the AEP are generated. Identifying these specific

The Basics About the Navy Marine Mammal Program

BEGINNING IN 1959, the Navy began to study the hydrodynamics of the dolphin, with the goal of improving torpedo, ship and submarine designs. Soon the Navy realized that dolphins had other attributes that would make them valuable assistants to Navy divers. Unlike human divers, dolphins are capable of making repeated deep dives without experiencing decompression sickness. They also found that dolphins and sea lions are highly reliable, adaptable and trainable marine animals that could be conditioned to search for, detect and mark the location of objects in the water. Both species are used today to search for lost equipment or vessels on the ocean floor, and to locate and mark sea mines. Over the years, Navy scientists have also studied dolphin behavior and physiology to help learn more about how dolphins are able to swim so fast, dive so deeply, and hone in on underwater objects so precisely.

Today, the Navy cares for, trains, and relies on two species: the bottlenose dolphin and the California sea lion. Both of these species are known for their trainability, adaptability, and heartiness in the marine environment.

For more about the Navy MMP, visit www.public.navy.mil/spawar/Pacific/71500.



TOP: A dolphin looks at the camera as he enters the hoop station in preparation for an echolocation trial.

BOTTOM: A dolphin positioned in the hoop station during an echolocation trial.

Diana Samuelson

anatomical sites within the brain will help researchers better understand echolocation signal processing. Testing will initially begin with the dolphin out of water—the dolphins' outgoing clicks will be recorded using a contact hydrophone placed on the head, and phantom echoes returned to the dolphins using contact transmitters ("jawphones") placed on the lower jaw. This out-of-water experimentation allows for precise and consistent placement of a relatively large electrode array, high signal-to-noise ratios for physiological recordings, and minimization of extraneous noise from subject movement. Further sessions would focus on repeating measurements with an electrode array while the dolphins perform the task under water.

In order for Navy ATR systems to achieve the same performance in complex acoustic environments exhibited by dolphins, their design may need to be re-imagined along biological terms, rather than emulating biosonar using conventional methods. This requires a much greater understanding of how dolphins form biosonar representations and make decisions regarding echoic discrimination and classification. This effort hopes to provide direction toward that goal. 🐬

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Navy's Environmental Stewardship Exhibit Opens at Wallops Flight Facility

Traveling Exhibit Educates While it Entertains

OFTEN WHEN YOU see a group of kids huddled around an electronic device, they're viewing selfies or watching video clips—but kids gathered around a tablet at the National Aeronautics and Space Administration's (NASA) Wallops Flight Facility in Virginia are listening to a variety of distinct whistles, clicks, and rumbling noises. These are sounds of the sea that visitors can listen to as part of the United States

Fleet Forces (USFF) Command's "Stewards of the Sea: Defending Freedom, Protecting the Environment" traveling exhibit. The exhibit helps visitors learn to distinguish between differing whale, dolphin and seal species as well as sounds like earthquakes, ice calving, and boat engines.

The exhibit, which focuses on Navy environmental stewardship, kicked off its two-year traveling tour on March 17, 2016.

The folks coming will get a glimpse of the Navy outside of how they typically think of them as protecting our country.

—William Wrobel



The "Stewards of the Sea: Defending Freedom, Protecting the Environment" exhibit at the NASA Wallops Flight Facility Visitors Center.

Ted Brown

Nothing can replace actual training in a realistic marine environment...
this exhibit will help us to tell that great story.

—Rear Admiral Chris Sadler

“The folks coming will get a glimpse of the Navy outside of how they typically think of them as protecting our country. It adds a new sidebar that they are protectors of the environment and the U.S.,” said Wallops Flight Facility Director William Wrobel.

The Stewards of the Sea traveling exhibit is a scaled-down version of the permanent exhibit on display at the Hampton Roads Naval Museum at Nauticus, the National Maritime Center in downtown Norfolk. After two successful years at the museum, the environmental outreach program expanded to include the traveling exhibit.

“Our environmental outreach mission is to raise awareness of the Navy’s need to train, and provide a better understanding of the protective measures the Navy takes while training,” said Tracy Riker, USFF environmental readiness and planning section head. “The end state is an increased public awareness and confidence of the Navy’s environmental stewardship efforts while accomplishing our mission.”

Part of the Navy’s process of conducting training and testing activities is maintaining environmental readiness through compliance with environmental laws. This includes analyzing potential impacts of training and testing activities on resource areas, including sediments and water quality, air quality, marine habitats, marine animals and vegetation, as well as cultural resources, socioeconomics, and public health and safety.

“It [the exhibit] explains the mitigation measures that we take before and during our exercises at sea including activities that involve active sonar and munitions in order to minimize any chance of our actions negatively impacting marine species,” said Rear Admiral Chris Sadler, USFF reserve deputy director of maritime operations, who spoke at the exhibit’s opening. “Nothing can replace actual training in a realistic marine environment... this exhibit will help us to tell that great story.”

The sounds of the sea audio gallery provides visitors insight into the challenges sonar technicians face while trying to detect ultra-quiet submarines, as they have to be able to identify and correctly differentiate between marine mammals, natural sounds, and man-made noise.



Laura Busch, a natural resources specialist assigned to USFF Command, plays a video for Dave Mergan and his two daughters at the “Stewards of the Sea: Defending Freedom, Protecting the Environment” exhibit.

Todd Kraft



Fire Controlman 1st Class Jason Mosher discusses how the Navy compresses plastic waste with a child at the “Stewards of the Sea” exhibit. The Navy uses plastic waste processors to compress and melt shipboard-generated plastic waste into dense disks suitable for long-term storage.

Lt. Bobbie A. Camp



A visitor looks through the “Big Eyes” interactive during the grand opening of the “Stewards of the Sea” exhibit.

Lt. Bobbie A. Camp



Evelyn Shotwell, executive director of the Chincoteague Chamber of Commerce, reads about the science of sonar during the grand opening of the “Stewards of the Sea” exhibit.

Lt. Bobbie A. Camp

“The ocean is generally noisier in coastal areas where about 80 percent of ocean life and many human activities occur, which is typically where most nations’ submarines operate today,” said Joe Atangan, a science advisor from USFF. “Many nations and potential adversaries have ultra-quiet submarines with long range missiles and torpedoes that can directly threaten our homeland and naval forces, as well as the world’s merchant shipping which carry 90 percent of all international trade by volume.”

Like the permanent exhibit, the traveling exhibit also highlights steps the Navy takes to protect marine life through shipboard plastic waste management.

“You’d be surprised at how shocked visitors are to find out that we even recycle,” said Yeoman 1st Class Agileo Bello, USFF administration department lead petty officer, who volunteers at local outreach events. “It’s been a great experience to educate the next generation about

the Navy in general and our environmental programs.”

Looking through giant “Big Eye” binoculars available at the exhibit, a visitor can be a virtual Sailor and scan the horizon, simulating standing lookout duty on a ship that is underway. Visitors may spot a whale pod, a flock of sea birds, or even some seals. This simulation allows visitors to “report” their sightings to the captain just as a Navy lookout would, enabling the ship to operate safely and avoid causing harm to the marine mammals.

The exhibit also explores the science of sound and the accompanying research the Navy conducts to better understand the effects of manmade sound, like sonar, on marine animals.

The Stewards of the Sea traveling exhibit will begin to rotate to locations in Washington, D.C. after Labor Day. Over the next two years, it will continue touring at a variety of museums throughout the country.

“For 2017, we’re targeting science and maritime museums in Chicago, Florida, North Carolina and New York to try to reach the public outside of fleet concentration areas to inform them about the Navy’s environmental stewardship efforts,” said Riker.

The permanent exhibit at the Hampton Roads Naval Museum will expand to feature the Navy’s energy initiatives within the next couple of years. For more information about the Stewards of the Sea program visit www.public.navy.mil/usff/environmental/Pages/default.aspx. 

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EMFN LUIS GUITERREZ



ELECTRICIAN
USS MAKIN ISLAND (LHD 8)

“*Did you know that by using hybrid electric propulsion systems 50 percent of the time, we can increase time on station by as much as two-and-a-half days? These systems can also increase the time between refuelings. This means extra time on station or greater endurance when the ship’s Captain and crew may need it the most.*”

Q: WHAT’S IT LIKE WORKING ON USS MAKIN ISLAND?

When I joined the Navy, I wasn’t quite sure what I was getting into. I had no idea that I was going to be working on a ship with such advanced technology. So, when I first came on board Makin Island, I was really excited. I felt like I was going to be one of the few who would actually be able to experience this ship. I felt like it was some kind of a future ship, like Star Wars or something. As an electrician on board Makin Island, I work on the ship’s electrical distribution system, the generators, the 400 hertz system, and the degaussing (demagnetizing) equipment. Not many people can say they work on a ship with hybrid propulsion; this is something I take great pride in. I felt blessed that I was able to get a ship like this for my first ship.

Q: WHAT WOULD YOU TELL OTHER SAILORS ABOUT WORKING ON A SHIP WITH A HYBRID DRIVE?

I would tell others Sailors that it’s something to be excited about. It’s a little bit different and can be complicated at times. If a problem arises, we often have to go through a lot of trial and error to solve it. There isn’t always someone who can answer your questions since it’s still kind of new to all of us. But once you’ve taken the time to figure it out, then you’ll be the person people always go to for help and you’ll be able to say, “Oh yeah, I had that problem once. Let me help!”





Q: WHY IS BEING ENERGY EFFICIENT IMPORTANT FOR THE NAVY?

Being energy efficient is important not only because it allows the Navy to save money but also because we are trying to keep this environment as clean as possible for future generations. Leadership talks a lot about going green but sometimes we ignore it. But who doesn't want to refuel less often? If you can save money, help our environment, and refuel less often, why not be energy efficient?

Q: HOW DO ENERGY EFFICIENT TECHNOLOGIES SUCH AS HYBRID PROPULSION BENEFIT THE NAVY?

The hybrid drive allows us to stay on station longer. Because the hybrid system consumes less fuel at slower speeds, drawing energy from the ship's generators rather than the gas turbines, we are able to stay out at sea for a longer period of time. At one point, the only reason we had to come back to replenish was because we had to get food. Other ships normally have to get fuel before food but because we have this technology on board, we often had to get food before fuel. While this can be a bit stressful at times, it does allow us to better accomplish our mission.

Q: WHAT ARE YOU MOST PROUD OF?

I'm most proud of the way my lifestyle has changed. I was a completely different person when I was a civilian. I never expected myself to be out in the middle of the sea—working here. I was just one of those kids who had other goals in life. Working with the hybrid drive and all the new equipment on board is exciting—I never stop learning.

Q: WHAT'S THE BEST PART OF WORKING ON MAKIN ISLAND?

It's so cool to be working on Makin Island. The hybrid drive makes it a unique ship—it's great. But, the best thing about it is the people I work with. People say we are co-workers but we're more like a family, especially while on deployment. We have a love-hate relationship—one day you won't talk to them, the next you're like brothers and sisters.

Q: WHAT MOTIVATED YOU TO JOIN THE NAVY?

I really felt like I wasn't doing enough for myself and that I could be doing more. My mother has been taking care of my brothers and me all by herself our entire lives. I wanted to make her proud, so she could brag about her son.

Q: IS SHE BRAGGING?

Yes. She is definitely bragging now.

Naval Sea Systems Command Launches Game Changing Technology for Fuel Conservation

GENISYS Software has the Potential to Enhance Warfighting Capability

A NEW SOFTWARE platform, created from existing technologies, is poised to provide the Navy's first truly complete picture of how energy is being used by ships and ultimately, how it can be conserved.

Every day, U.S. Navy ships consume approximately 80,000 barrels of oil worldwide as they train and perform their missions. Depending on the type of ship and the mission profile, conventionally-powered ships are often refueled every four to five days at sea.

The day-to-day decisions of operational commanders, as well as highly variable environmental and mission factors, can have a large impact on this energy consumption. As an example, a ship that is maintaining position within a specific latitude and longitude range offshore for ballistic missile defense purposes during calm seas may be able to safely secure engines and use drift operations at certain times to save fuel. However, a ship doing the same mission with high sea states, storms and strong currents typically cannot use drift operations, and will use much more fuel to stay in position.

To better understand how these many factors influence fuel use and draw applicable

conclusions, it became apparent that disparate pieces of data would have to be combined from multiple systems. This would require an unprecedented level of cooperation among various commands. The Naval Systems Engineering Directorate, Technology Office at the Naval Sea Systems Command (NAVSEA 05T) with help from CDI Inc. leveraged existing technology from United States Fleet Forces (USFF) and Commander, U.S. Pacific Fleet (COMPACFLT) to create the Global Energy Information System (GENISYS). Built upon several existing technologies, GENISYS is designed to establish a clear link between fuel use data and mission/environmental data.



The Arleigh Burke-class guided-missile destroyer USS Truxtun (DDG 103) conducts a replenishment-at-sea. Truxtun successfully participated in a GENISYS eLogBook trial in December 2015.

MCS2 Tony D. Curtis

GENISYS will be utilized at the earliest stages of energy conservation—the design of more energy-efficient ships.

Funding for this project was provided by the Chief of Naval Operations Energy and Environmental Readiness Division, Energy Coordination Office (OPNAV N45E).

The Evolution of GENISYS

GENISYS effectively links three existing technologies to help provide a clear picture of the factors that affect fuel consumption.

1. The Integrated Condition Assessment System

The Integrated Condition Assessment System (ICAS) was created to improve maintenance and increase operational efficiency onboard Navy ships. Approximately 16 years ago, engineers at Naval Surface Warfare Center Philadelphia Division (NSWC PD) installed sensors on shipboard engines and equipment on select ships. These sensors transmit real-time data to NSWC PD, and is used to address performance and maintenance needs and to identify potential class-wide problems.

In 2009, NAVSEA realized that they could tap into the ICAS signal to provide direct feedback to the ship regarding how fuel and electrical energy was being used onboard in real time. “We could track the fuel being burned to navigate the ship as well as how much fuel was being burned to make or create energy by various ship components—the Heating Ventilation and Air Conditioning (HVAC) system for example,” said Michael Essig, Maritime Energy Manager at NAVSEA.

Using the information gathered by ICAS, the Shipboard Energy Dashboard was created in 2010. This system provides the Sailor with real-time situational awareness of the energy generation and demand associated with equipment lineups and efficiencies. Since 2012, NAVSEA installed Shipboard Energy Dashboards onboard 18 ships.

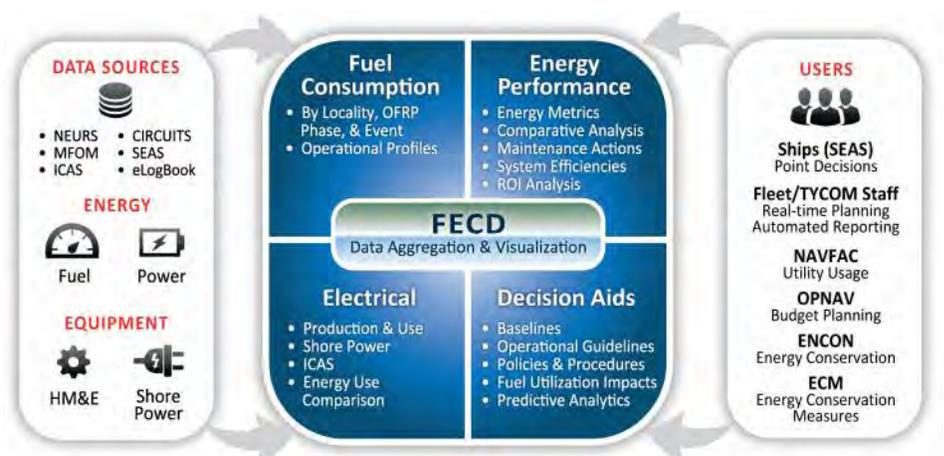
2. The Energy Figure of Merit

Under a separate effort, USFF was looking for a way to better train and evaluate ship’s crews regarding the effects that a ship’s environment (waves, wind, currents, etc.) and mission requirements had on fuel and energy efficiency—for example, how to differentiate the efficiencies of two ships performing different missions in different environmental conditions. USFF developed a new formula known as the Energy Figure of Merit, which helped ships analyze the

impacts of environmental elements, mission requirements and maintenance. The formula informed the ship of how energy was truly being used onboard while taking into account all the other external variables.

3. The Fleet Energy Conservation Dashboard

Meanwhile, COMPACFLT was trying to better analyze shore energy use and ways to decrease the Navy’s carbon footprint. Newly-hired energy managers monitored and studied how shore power and energy were being used to create the Fleet Energy Conservation Dashboard (FECD). This web-based graphical interface provides an on-line view of energy information and enables users to identify trends and problem areas. Once deployed, FECD will be used to identify and cut energy costs for homeport ships. In-service engineering agents supporting the Fleet



FECD is a web-based graphical user interface that provides an online view of energy information, enabling users to make informed decisions. The user has the ability to drill down and roll up cost and energy data by date, time, fleet, ship type, class, flight, homeport, system, equipment type, equipment, as well as other criteria.

will use the FECD to evaluate and compare performance of various systems and equipment.

Achieving A Real-time Energy Picture

As the NAVSEA team studied the potential for combining these systems, the first problem they encountered was the fact that none of these systems was able to communicate with each other.

However, before integrating each part, some changes had to be made to the planned “backbone” of the system—the Shipboard Energy Dashboard. The dashboard, as it existed, allowed some capability for users to input a limited number of mission codes. However, these codes were insufficient for capturing the myriad real-life scenarios that encompass a mission activity.

The GENISYS team realized that achieving an accurate real-time energy picture would mean inputting data from the ship’s log.

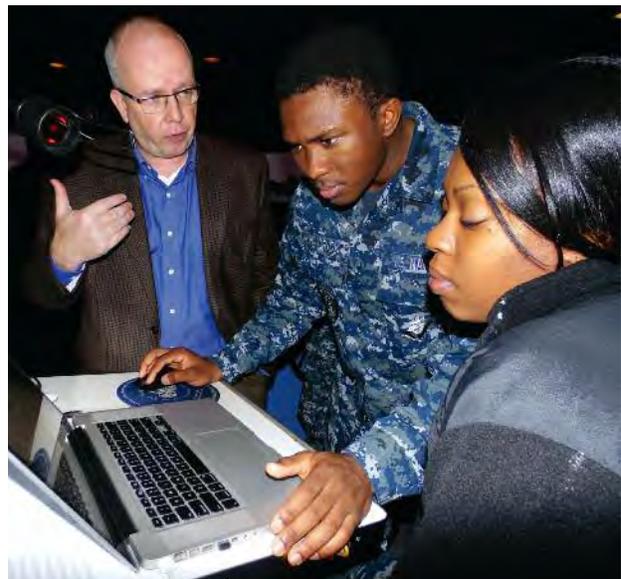
eLogBook

A ship’s log is a daily chronology of a ship’s location, movements, and selected other data. Information has always been entered into these logs by hand. In order to capture the data needed to create GENISYS, without creating more work for Sailors, the best solution was to digitize these logs at the point of collection.

Created in 2014 with the assistance of Beacon Interactive Systems, eLogBook is an electronic tool that allows Sailors to enter information into a database instead of writing it

out by hand. To save time and improve accuracy, this software platform includes templates pre-populated with some generic data. eLogBook also digitizes and integrates various shipboard operational data logs, so that everyone onboard ship has instant access to real-time data on mission parameters, operations, combat systems, and daily fuel, oil, and water usage.

The eLogBook tool has the additional advantage of eliminating the problems associated with the archiving of physical log books.



Jim Haley, Director of Energy & Maintenance Analytics at Beacon Interactive Solutions instructs crew of USS TRUXTUN during the GENISYS eLogBook trial in December 2015.



Quartermaster 3rd Class Brandon Shannon writes an entry into the ship’s deck log during a quartermaster watch.

MCS3 Betsy Knapper



The eLogBook mobile tablet.

Energy from Alternative Sources

IN KEEPING WITH the energy goals set by Secretary of the Navy Ray Mabus, the Department of Navy is seeking to lessen its dependence on fossil fuel and to provide 50 percent of overall energy from alternative sources by 2020.



The SEAS dashboard display.

Putting it All Together

To merge the eLogbook with ship-board sensor data (provided by ICAS), the Shipboard Energy Dashboard was redesigned into an agile yet cyber-secure interface that manages ship-board energy and provides recommendations for actions to improve energy efficiency—the Shipboard Energy Assessment System (SEAS). Finally, all captured data will be sent electronically to the shore-based FECD (now new and improved by Frontier Technologies Inc.), where it is aggregated into a centralized data warehouse and analyzed to support various stakeholder needs. The overarching system encompassing SEAS, eLogbook, and FECD was formed and named GENISYS.

The numerous advantages GENISYS provides to the Navy cannot be understated. In addition to providing direct feedback and real-time recommendations to a ship's Commanding Officer so that he/she can make adjustments to improve efficiency, range, time-on-station and operational flexibility, GENISYS also creates a one-stop shop housed in the FECD. This resource allows users, via protected web access both ashore and at-sea, to view a variety of metrics, statistics and planning applications in real time, in a searchable, easy-to-access format.

“If I have a condition,” says Essig, “and I have a desired outcome, then [with GENISYS] I can fill in the blank.” This ability to program simulations using actual operational performance data will also add value to Navy training. The training environment allows for “what if” scenarios predicting energy outcomes of changes in equipment and speed using a library of real operational data. This potentially shortens the length of trainings, eliminates excess waste, and educates the warfighting force more effectively.

The Future of GENISYS

NAVSEA will test the GENISYS software onboard eight Great Green Fleet ships toward the end of 2016. The goal is to monitor how the Great Green Fleet is operating, and confirm that the GENISYS models work as expected. Following the conclusion of the Great Green Fleet test, GENISYS will be rolled out for use Fleet-wide with enterprise Remote Monitoring (eRM) which is the follow-on equipment sensor and monitoring system that will replace ICAS. GENISYS will be added to the existing system onboard USS Arleigh Burke (DDG 51)-class destroyers in 2019. Navy cruisers and other classes will follow.

In addition to the energy gains that GENISYS could provide, the system also exemplifies an innovative Navy in action. Instead of creating a system from scratch, the GENISYS team focused on integrating systems already in use, and uses traditional Navy log-keeping in a modern way.

Down the road, GENISYS's creators envision that the system will be utilized at the earliest stages of energy conservation—the design of more energy-efficient ships. Essig sums up the future of GENISYS when he says, “Being able to have the real-time data captured by GENISYS and compare it to other ships within the Navy allows the Navy to build an accurate, Navy-wide assessment of how operations are done and determine ways to improve them. The Navy has collected operational and engineering data for ages. With powerful processors and agile data management we can finally put all that data together to create a true picture of energy use. We believe that that picture will tell us a lot.” [↗](#)

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Chief of Naval Operations Environmental Award Winners Recognized

Accomplishments Exemplify Navy's Commitment to Environmental Stewardship

THE NAVY HAS announced the 29 winners of the fiscal year (FY) 2015 Chief of Naval Operations (CNO) Environmental Awards. The annual awards program recognizes ships, installations, and individuals for their exemplary environmental achievements.

The competition categories for the FY 2015 competition included natural resources management (small installation and individual/team), environmental quality (non-industrial installation and individual/team), sustainability (industrial installation), environmental restoration (installation and individual/team), cultural resources management (large installation), environmental excellence in weapon system acquisition (large program), and afloat (includes five competitive sub-categories).

Subject matter experts from the Navy and other non-governmental organizations judged the individual nominations on accomplishments during the 1 October 2013 through 30 September 2015 eligibility period. Chief of Naval Operations Admiral John Richardson recognized the 29 award winners during a video teleconference ceremony held 30 June 2016 at the Pentagon in Washington, D.C.

Accomplishments of the winners are highlighted below.

Natural Resources

This award recognizes efforts to promote the conservation of natural resources, including the identification, protection, and restoration of biological resources and habitats; the sound long-term management and use of the land and its resources; and the promotion of a conservation ethic.

Small Installation

Commander Fleet Activities, Yokosuka, Japan

Commander Fleet Activities (COMFLEACT), Yokosuka is working to preserve natural resources found on the installation through environmental stewardship and community outreach. To optimize their effectiveness, COMFLEACT Yokosuka has cultivated partnerships with technical experts specializing in Japanese environmental requirements and local governments, including the cities of Yokosuka, Zushi, and Yokohama.

The firefly is both a living cultural Japanese icon and ecologically significant. The Natural Resources Program (NRP) at Yokosuka focused tremendous efforts to protect the firefly habitat. Staff reduced artificial lighting, created vegetation buffer zones, modified grass cutting areas, and limited the use of harmful soap and detergents within the firefly's habitat. Additionally, NRP's management successfully bred over 800 fireflies in 2015.



SEABEES construct educational signage at Ikego Camp Grounds as part of efforts to protect the area's natural features. The pond in background is prime firefly habitat and foraging area for migratory birds.

Ryoko Arak



Survey and trapping of aquatic wildlife at Ikego ponds. Surveys of wildlife both native and non-native are being conducted along with the elimination of exotic species.

Hisako Mawatari

Yokosuka allocated funding to conduct studies to determine current land and marine natural resource levels, including bird populations. These projects are the first of their kind and will assist developers and builders in avoiding development in areas deemed essential habitats for threatened species.

Naval Air Facility, Atsugi, Japan

The environmental team at Naval Air Facility (NAF) Atsugi has implemented innovative methods to preserve natural resources, working alongside local farmers and government officials. One example of this work is the relocation of hundreds of honey bees by NAF Atsugi staff and local beekeepers. Bees are a dwindling species in the local agricultural areas where Atsugi is located. Relocating the bees provided a great opportunity for those working at NAF Atsugi to strengthen their relationship with both the surrounding community and the environment.

The NAF Atsugi Environmental Division is using tracking tools and technology to ensure that natural resources are protected during the lifecycle of a project, which encompasses construction, repair and maintenance work. These efforts ensure that natural resources are available for all to enjoy for generations.

*Pacific Missile Range Facility
Barking Sands, Hawaii*

Pacific Missile Range Facility (PMRF) Barking Sands is the world's leading multi-dimensional integrated test and training range. Bordered by the Pacific Ocean, the facility is home to an abundance of natural and native resources including protected species. PMRF has made the protection of native wildlife a priority. The base provides patrolled beachfront to safeguard and monitor green turtles, a threatened species in Hawaii, so that the turtles can successfully nest. In 2015, a documented 499 eggs were laid with 468 successfully hatching. PMRF is also home to endangered Hawaiian monk seals. At the base the seals are provided with a safe habitat and available for academic research.

Staff implemented a base-wide Dark Sky Initiative at PMRF to protect endangered avian species such as the Newell's Shearwater, the Hawaiian Petrel, and the Band-rumped Storm-Petrel. They are most vulnerable during the fall season which is a critical developmental stage when first learning to fly. Light pollution has been known to adversely affect the birds during this important period of their lifecycle. The Dark Sky Initiative helps to minimize the "fallout" of artificial evening light.



NAF Atsugi promotes environmental stewardship across the base.

Individual or Team

Ian Trefry of Portsmouth Naval Shipyard, Maine

Mr. Ian Trefry works at Portsmouth Naval Shipyard, in Kittery, Maine as the Natural Resources Manager for Naval Facilities Engineering Command Mid-Atlantic (NAVFAC MIDLANT) Public Works Department- Maine Environmental Division. His work has tremendously impacted environmental sustainability, as his area of responsibility includes 19 Navy installations and reserve centers, a staff of over 7,000, and over 16,000 acres of land spanning six states throughout the Northeast. The land he has sought to preserve supports over 100 species that are vulnerable to extinction and more than 5,000 acres of wetlands.

Over his years of service Mr. Trefry has created partnerships with other



Ian Trefry and NAVFAC MIDLANT biologist Chris Petersen document vernal pool habitats at the Great Pond Outdoor Adventure Center. The results of this survey facilitated updates to the installation Integrated Natural Resources Management Plan, assisted with facility planning, and aided in community outreach activities.

Ian Trefry

Dr. Eric VanderWerf and Robby Kohley hand feed a Laysan albatross chick recently transferred to its protected outdoor enclosure.

John Nelson





An installation conservation law enforcement officer gets assistance from NASO utilities crew and equipment to rescue a juvenile osprey from a nest located on a utility pole at NASO Dam Neck Annex that caught fire earlier in the day after a storm event.

governmental agencies and non-governmental agencies to support environmental research that is estimated to have saved the Navy tens of thousands of dollars. Mr. Trefry was also a key player in the Readiness and Environmental Protection Integration Program that provided conservation easements for approximately 10,000 acres of land bordering the Survival, Evasion, Resistance, and Escape School East Training Facility (SERE EAST). This protected land not only preserves New England's wilderness but it also provides realistic training for SERE EAST and buffers the installation from encroachments.

Naval Air Station Oceana and Naval Support Activity Hampton Roads Northwest Annex Natural Resources Support Team, Virginia

A dedicated group of individuals are assigned to provide environmental services at Naval Air Station Oceana (NASO) and have assignments at Naval Support Activity Hampton Roads Northwest Annex (NSAHR NWA). Their work covers over 15,000 acres of land that the Navy owns or leases, plus an additional 140,500 acres of easements and nearshore environment. The group is supported by a vast network of individuals, including 19 members of the natural resources team from NASO and NSAHR NWA.

The team works collaboratively with in-house support, contractors, co-operators, regulatory agencies, lessees, and volunteers. The projects that have been executed by the team have provided information on land management, vegetation, and wildlife habitat, so that educated decisions can be made to both accomplish the military

mission requirements and maintain natural resource compliance. This collaborative approach has saved the Navy hundreds of thousands of dollars, as well as many natural resources.

Southwest Marine Biology Team of Navy Region Southwest and NAVFAC Southwest, California

On 8 December 2014, a carcass of a 2,000-pound whale was discovered in San Diego Bay near Naval Air Station North Island. The specimen was originally thought to be a minke whale, one of the most plentiful whale species in the world, but upon further inspection it was determined to be a juvenile Bryde's whale. Bryde's whales are common in tropical waters, but sightings are uncommon in California. Scientific studies indicate that Bryde's whales are becoming more common in the waters off Southern California. This stranding could be indicative of the population's growth.

Two days after the discovery of the whale carcass, a group of scientists from the Navy's Southwest Marine Resource Management Team, the National Marine Fisheries Service (NMFS), the Southwest Fisheries Science Centers, and the San Diego Museum of Natural History worked to preserve the whale for the museum's collection and to investigate the creature's cause of death. The whale will be available for the public to view and for academics to study, as the only complete specimen of a Bryde's whale in a museum on the west coast.



The baleen array pulled from the carcass. Recovery of this specimen with a fully intact baleen array was one of the highlights of preserving this specimen of Bryde's whale. It is now the only complete skeleton of Bryde's whale with a full baleen array in a research collection in the U.S.
Walt Wilson

Environmental Quality

These awards recognize efforts to ensure mission accomplishment and protection of human health in the areas of environmental planning, waste management, and environmental law and regulation compliance. Meeting or exceeding all environmental requirements not only enhances the protection of our environmental assets, but also sustains the Department of Defense's (DoD) ability to effectively train and maintain readiness.

Non-industrial Installation

Naval Medical Center Portsmouth, Virginia

Naval Medical Center Portsmouth and its outlying clinics provide quality patient-centered healthcare to over 420,000 active-duty and retired service members and their families. As the Navy's oldest continuously operating hospital, it maintains its "First and Finest" tradition by successfully integrating its environmental management system program into all aspects of healthcare delivery. Through environmental stewardship over 600,000 pounds of plastics, cardboard, and privacy curtains were diverted from entering landfills in FY15. Additionally, an aerobic digester enabled the diversion of over 200,000 pounds of food waste. The center was able to reduce medical waste in FY15 by 36 percent when compared to FY14 levels.

The center also purchased and installed waterless mops for housekeeping to use throughout the clinics in March of 2015. These mops have zero discharge to the sanitary sewer and help to eliminate cross contamination.



Hospital Corpsman providing vaccine to patient.



The excavation and bottom drain for a 600 by 200 foot bioretention area for reducing pollution in stormwater runoff. Best management practices implemented during the award period such as this one will reduce stormwater runoff of nitrogen, phosphorus, and suspended solids by over 11 tons per year.

Naval Support Activity Mechanicsburg, Pennsylvania

Naval Support Activity Mechanicsburg (NSA-M), which includes its namesake, Naval Support Activity Philadelphia and the Philadelphia Naval Yard Annex, collectively employs approximately 12,000 people. NSA-M achieved many major environmental accomplishments in FY15. NSA-M reduced their energy consumption by 9.5 percent compared to the previous fiscal year; this resulted in over \$4 million in savings. The key to meeting these energy reductions has been the establishment of a building monitoring and energy audit program.

Looking ahead, NSA-M has been awarded \$3.1 million to fund projects that will reduce stormwater pollution runoff of nitrogen, phosphorus, and suspended solids by over 11 tons. The projects will allow NSA-M to meet Chesapeake Bay pollutant reduction permit requirements with the use of roof-disconnect planter boxes, dry and vegetated swales, rain gardens and bioretention facilities.

Navy Region Center, Singapore

Navy Region Center Singapore's (NRCS) environmental team plays an important role in maintaining compliance with U.S. environmental guidance and applicable local laws and regulations, and the facility's quality of life. Staff reduced solid waste disposal by 44 percent despite a 22 percent increase in population from FY13. A major factor that contributed to this reduction was a 128 percent increase in recycled waste from FY13 to FY15. The installation also trimmed energy consumption by 36 percent when compared to the 2003 baseline number; this equals a savings of \$70,000 a year, despite the significant population growth.



Representatives from United Kingdom Defense Fuels Group Singapore, PSA Corporation, Singapore Civil Defense, Interagency Auxiliary Police Force, and NRCS participate in the joint spill response exercise conducted in FY15. The exercise provided heightened awareness and significantly increased the spill response capability of all parties.

Teo Kok Sing

Through the excellent environmental quality program, managed by the environmental team, the command has prospered in cost savings and improved readiness. A key facet of NRCS's environmental success is providing a sense of personal contribution, ensuring that programs will be maintained and successfully transitioned through changes of command and personnel.

Individual or Team

Commander Fleet Activities Yokosuka Public Works Department Environmental Management Division Team, Japan

A staff of over 30 engineers, environmental specialists, program managers, program analysts, and technicians make up Commander Fleet Activities (FLEACT) Yokosuka's Environmental Division. The team works vigorously to implement environmentally sound measures in accordance with Japan Environmental Governing Standards and applicable Japanese and U.S. regulations, laws, policies, and requirements.

At Yokosuka waste diversion continues to be a staple ingredient in its environmental success through an ever-evolving recycling program. By revamping and simplifying awareness

training, participation in the environmental management program has improved, despite the installation's typically high personnel turnover.

The diversion rate for construction and demolition debris at Yokosuka is an impressive 66 percent, due in large part to improvements to an environmental Statement of Work template that is used for all new contracts, which now requires participation in the recycling program and a better accounting of recyclable materials.

Yokosuka's Qualified Recycling program has generated approximately \$1.7 million in income. These funds have been reinvested into safety programs, pollution prevention initiatives and Morale, Welfare and Recreation support.

Naval Station Norfolk Environmental Compliance Team, Virginia

The Naval Station Norfolk environmental compliance team provides technical, permit management, and spill management support to Naval Station Norfolk. The efforts of the team contributed to improvements to the installation's stormwater system. These modifications allowed the installation to surpass



A member of the environmental team collects a drinking water sample from a water faucet. This activity is one of many sampling events the Environmental Division conducted between FY14 and FY15.

Yoshiaki Kanazawa

2018 pollutant reduction goals for the Chesapeake Bay region, three years earlier than required. The development of construction site inspections, which ensure that sediment is not discharged to storm drains and subsequent waterways, and incorporation of best management practices to filter out pollutants contributed to this achievement.



Environmental services personnel clean up a spill pierside. Through periodic shipboard spill training, working with Type Commands to evaluate root cause, and other outreach, Naval Station Norfolk has exceeded its EMS targets in spill reduction.
Ricky Cambridge

The team has also created a partnership with the Virginia Industries for the Blind to form a free fire extinguisher recycling initiative. Naval Station Norfolk currently has over 2,000 extinguishers stockpiled. By recycling the fire extinguishers, 500 man hours and \$80,000 will be saved.

NAVFAC Northwest Environmental Management System Team, Washington

The NAVFAC Northwest Environmental Management System (EMS) team works to provide environmental support to several installations that cover over 91,000 acres of land in 11 states.

At Naval Magazine Indian Island, the team exceeded its goal of reducing energy consumption by 30 percent in FY15 by achieving a 60 percent reduction in energy intensity compared to the established 2003 baseline. Two major projects were completed in FY14 and FY15 that

led to the significant reduction in energy consumption: the installation of modern Industrial Control Systems that created an annual energy savings of 1,846 million British Thermal Units (BTU) per hour and the replacement of street and exterior building lighting that saves 1,334 million BTUs annually.

The stormwater at Naval Base Kitsap (NBK) discharges into the Puget Sound, a protected body of water that requires special attention. In order to prevent copper and zinc contained in dust

kicked up by trucks from entering into Puget Sound, staffers installed a stormwater rain garden, with support from the EMS team, to filter out contaminants.

Sustainability

These awards recognize efforts to prevent or eliminate pollution at the source, including practices that increase efficiency and sustainability in the use of raw materials, energy, water, or other resources. Sustainable practices ensure that DoD protects valuable resources that are critical to mission success.

Industrial Installation

Fleet Readiness Center Southeast, Florida

Fleet Readiness Center Southeast (FRCSE) provides maintenance and repair services including in-depth modifications and overhauls of naval aircraft, engines, weapons systems and components. The command is dedicated to meeting environmental, energy, and economic performance goals.

FRCSE recycled 160 tons of used oil and reclaimed eight tons of turbine blades for rhenium extraction in FY14 and FY15. The command also expanded its metals reclamation program to include 49 tons of F404, F414, and TF34 engine components. Two AE-6B Prowler aircrafts were reclaimed at the command in FY15, recycling 19 tons of aircraft material and recovering aircraft parts for a cost avoidance of \$14.5 million.

The FRCSE environmental office established goals to develop environmental knowledge down to the individual shop level. These efforts involved training each artisan, coaching the shops, scoring performance, and reviewing and correcting



Navy Region Northwest biologists conduct sampling of shellfish species within the intertidal zones at NBK Bremerton. The study was conducted to determine the appropriate biologically active zone for shellfish within the intertidal portion of the remedial action area.



Charles Miller, an FRCSE material identifier, washes a bin of aluminum scraps collected through the manufacturing process. Washing the scraps removes oil residue and dust so the metal can be taken to Defense Logistics Agency Disposition Services for resale.

Clifford Davis

procedures. These efforts increased shop awareness and adherence to environmental compliance requirements and resulted in an 80 percent reduction in the number of non-conformities found during reviews.

Fleet Readiness Center Southwest, California

Fleet Readiness Center Southwest delivers responsive maintenance, repair, and overhaul products and services in support of naval aviation and national defense objectives. In FY15 the facility delivered 164 aircraft, 38,500 aviation components, 99 aircraft engines and 22 marine gas engines to the Fleet.



The F/A-18 assembly/disassembly hangar was repainted with non-toxic paint to sustain health and safety compliance. The newly painted facility also improves natural lighting, reducing electricity consumption.

Waste prevention is practiced at the facility by recycling all feasible waste streams. The recycling program recycled 75 percent of all non-hazardous solid waste and 100 percent of all surplus electronics in FY15. Examples of hazardous waste recycling include 109,000 pounds of spent oil and petroleum products and 18,000 pounds of machine coolant.

Projects to reduce energy consumption included nighttime setbacks for foundries, removal of a data center, and sequencing air handlers with nighttime and weekend setbacks to more efficiently regulate temperatures. Results showed an electricity savings of 824 megawatt hours, a natural gas savings of 1,605 million BTUs, and a greenhouse gas reduction of 885,111 pounds, for a cost savings of nearly \$1 million.

NAVSUP Fleet Logistics Center San Diego, California

The Naval Supply Systems Command (NAVSUP) Fleet Logistics Center (FLC) San Diego provides combat capability through logistics support to 86 home-ported ships, submarines, transient vessels, and 11 over-the-horizon regional naval bases and air stations in California and Nevada.

Through significant research, the team at FLC developed an effective solution for chemical pretreating and processing 750,000 gallons of water contaminated with hydrogen sulfide at its fuel oil reclamation plant.

The fuel oil recovery system at FLC San Diego is a critical cost savings resource for the Navy. Approximately 1.5

million gallons of fuel are reclaimed by the system annually, generating over \$1 million in revenue. The recovered oil primarily comes from Navy vessels entering shipyards for maintenance. Without the fuel oil recovery system, oily water from the vessels would be treated as a costly hazardous waste, since the closest disposal facility is located in the Los Angeles Basin. The Navy achieves over \$14 million annually in cost avoidance through this successful program.

Environmental Restoration

This award recognizes efforts to protect human health and the environment by cleaning up identified sites in a timely, cost-efficient, and responsive manner. Restoring these sites impacted by



NAVSUP Fleet Logistics Center San Diego's Defense Fuel Support Point facility located on Naval Base Point Loma.

historic defense practices protects military personnel and the public from potential environmental health and safety hazards.

Installation

Joint Expeditionary Base Little Creek-Fort Story, Virginia

The environmental program at Joint Expeditionary Base Little Creek-Fort Story (JEBLCFS) has collaborated with various governmental agencies to balance the challenges of restoring environmental sites and protecting human health and the



Divers were used at JEBLCFS 's Solid Waste Management Unit 3 site to distribute powdered activated carbon across the sediment surface to reduce the bioavailability of contaminants in the upper biologically active zone. The use of amendments to actively sequester contaminants in sediment was less energy-intensive, less expensive, and less disruptive than conventional remediation technologies.

Louie McTall

environment with the facility's limited space, continued growth and mission need for usable land. The efforts at JEBLCFS have resulted in significant cost savings and made approximately 31 acres available for reuse.

Staff actively treated sites on the base via enhanced reduction dechlorination, with the use of "green" remedial technologies. This was achieved by injecting emulsified vegetable oil into the groundwater to promote the degradation of contaminants, from historical waste management practices.

Another environmental innovation at JEBLCFS was designating a portion of a landfill for beneficial reuse. The land was converted into an equipment storage area while maintaining the integrity of the existing soil cover, freeing up land for other constructive uses or conservation.

Portsmouth Naval Shipyard, Maine

Portsmouth Naval Shipyard (PNSY) is a 216-year-old facility with a long naval history, situated at the mouth of the Piscataqua River. Today, it serves as a nuclear-powered submarine maintenance facility. Throughout its history, many of the hazardous materials at the facility had been managed in accordance with outdated procedures which resulted in contamination at the shipyard.

The environmental program at PNSY is pursuing an aggressive schedule for cleanup. Notably successful remedial actions were executed at three separate sites, resulting in the excavation and proper disposal of over 24,300 tons of contaminated soils and sediments in FY14 and FY15.

The environmental team at PNSY is continually considering smarter, greener ways of conducting environmental remediation. For example, the



Upon completion of the FY14-15 dredging activities, a bathymetric survey confirmed appropriate removal of contaminated sediments that posed unacceptable risk to ecological benthic receptors. The remedial action considered the protection of the eelgrass bed located at one of the dredging locations and was completed within the federally and state approved in-water work window intended to protect the threatened and endangered species, Atlantic and shortnose sturgeon.

Frederick Matthew Thyng

team collaborated with the U.S. Environmental Protection Agency (EPA) and the Maine Department of Environmental Protection to design and implement an innovative method of using Portland cement to stabilize almost 9,000 tons of lead-contaminated soil to render it non-hazardous for handle and disposal. PNSY utilized this technique a few months later to address 107 tons of lead-contaminated soil that required treatment after dredging. This process saved over \$3 million in hazardous waste transport and disposal costs.



Individual or Team

Naval Base Ventura County Environmental Restoration Team, California

Naval Base Ventura County (NBVC), which is made up of multiple facilities in Southern California, provides airfield, seaport, and base support services to fleet operating forces and shore activities. The Environmental Restoration Team (ERT) at NBVC provides all aspects of Installation Restoration and Munitions Response Program oversight at NBVC. To date, a total of 72 of the 135 sites where restoration activities have been performed at NBVC are considered to be response complete. Thirteen of those sites achieved a response complete status during FY14 and FY15.

Through innovative partnerships and techniques, the team is not only able to achieve response complete status, but they are also able to find cost-effective solutions and reclaim land. By partnering with the Calleguas Creek Watershed Committee, the NBVC ERT was able to save \$10.2 million on the remediation of the Mugu Lagoon. At the Fort Hunter Leggett facility, an expeditious removal of munitions and explosives of concern was performed, which resulted in the reopening of seven acres of facilities critical for Navy mission use. Using a one-of-a-kind system, originally designed to separate pistachio shells from pistachio nuts, 25,000 pounds of lead shot and 918 tons of target debris were separated from sand at the Point Mugu Trap & Skeet Range Site. This innovative process led to a cost savings of \$500,000.

St. Juliens Creek Annex Environmental Restoration Program Partnering Team, Virginia

The primary mission of St. Juliens Creek Annex (SJCA) is to provide a radar-testing range, as well as administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local naval activities. In July of 2000, SJCA was added to the National Priorities List as a result of former operations conducted at the facility that resulted in environmental impacts. The SJCA Environmental Restoration Program Partnering Team was created to streamline the closure of the Environmental Restoration Program sites by using consensus-based site management strategies following the Comprehensive Environmental Response, Compensation, and Liability Act process. This team is a partnership between NAVFAC, the EPA, and the Virginia Department of Environmental Quality.

The team reduced the environmental impact of the remediation actions at two sites at SJCA through the utiliza-



Dense non-aqueous phase liquid (DNAPL) was discovered as wells were being installed for substrate injection to address contamination in the shallow aquifer groundwater. The team developed an approach to remove the DNAPL, resulting in immediate contaminant mass reduction.

Bonnie Roberts



Munitions response divers search the ocean floor for munitions to accelerate opening a planned public recreational area at the adjacent former Vieques open burn/open detonation site at the request of USFWS.

tion of several green and sustainable remediation techniques. Permanent injection wells were installed, which greatly reduced the amount of waste generated when compared to using temporary injection points. Emulsified vegetable oil, an innocuous substance, was also used to remediate the sites, reducing the risk of cross-contamination.

Vieques Environmental Restoration Program Team, Puerto Rico

Between the mid-1940s until 2003, more than 300,000 munition items were fired at the former Vieques naval installation during military training. A large portion of Vieques and the surrounding waters were placed on the National Priorities List in 2005.

The remediation project faces unique challenges, such as unexploded ordnances and their associated contaminants, across thousands of acres of land and sea floor. To meet these challenges and successfully implement environmental restoration, representatives from NAVFAC Atlantic, the EPA, the Commonwealth of Puerto Rico Environmental

Quality Board and Department of Natural and Environmental Resources, the NMFS, the National Oceanic and Atmospheric Administration, the Department of Interior, and the U.S. Fish and Wildlife Service (USFWS) work collaboratively as the Vieques Environmental Restoration Program Team.

In FY14 and FY15 over 560 acres were cleared of munitions at Vieques, resulting in the removal of over 7,000 munitions and over one million pounds of scrap metal being sent to a recycling facility. During the cleanup, divers recovered munitions across 200 acres of seafloor adjacent to the site, while ensuring threatened and endangered corals and other sensitive species/habitats were protected.

Cleanup has been accelerated using innovative strategies and groundbreaking technologies, such as a remotely operated long-reach excavator, used to remove highly dangerous munitions within heavily vegetated areas on roads and beaches. This technology is estimated to save the project over \$11 million.

Cultural Resources Management

These awards recognize efforts to promote cultural resources stewardship by highlighting outstanding examples of Cultural Resources Management (CRM). Awards are designed to showcase extensive cultural resources including archaeological sites, the historic built environment, and cultural landscapes. Desired initiatives include partnering with external stakeholders such as Native Americans, state historic preservation officers, and local communities, and those working with internal stakeholders, such as master planning, public works, and range management. Through cultural resources management programs, Navy and DoD identify areas likely to contain historical assets and work to protect these resources for future generations in partnership with Native American tribes and historic preservation authorities.

Large Installation

Naval Air Station Fallon, Nevada

Naval Air Station (NAS) Fallon is a 241,000-acre station whose primary mission is to provide integrated air training events in support of carrier air wings, marine air groups, and joint and multinational exercises. Located in the heart of ancient Lake Lahonton, the Fallon area includes archaeological sites that date back more than 10,000 years. Prehistoric burials have been found in cave and dune sites throughout the Lahontan Valley, including on NAS Fallon.

During FY14 and FY15, an archeological inventory was taken of over 14,000 acres, resulting in the discovery of nearly 500 archaeological sites. Other achievements included performing National Register of Historic Places evaluations for 66 archeological sites, and completing a maintenance plan for NAS Fallon's last remaining World War II-era hangar.

Volunteers from the University of Nevada, Reno and local archaeological community donated over 300 hours of services to the natural resources management program, illustrating the collaborative nature of NAS Fallon and the local community.



An archaeologist excavates a prehistoric cooking hearth on NAS Fallon bombing range B-16. During FY14 and FY15, 66 archaeological sites on NAS Fallon bombing ranges were evaluated for their National Register of Historic Places eligibility.

Naval Support Activity Crane, Indiana

Occupying 62,000 acres, Naval Support Activity (NSA) Crane's mission is to enable and sustain fleet, fighter and family readiness through consistent, standardized, and reliable shore support to tenant commands. The cultural resources program at NSA Crane encourages all of the NSA Crane family to become intimately connected to the history of southern Indiana and the Navy's installation to encourage the community's responsive behavior and stewardship for its resources.



Holt Rock Shelter is one of 78 known archaeological sites on NSA Crane.

NSA Crane surveyed over 230 acres for archaeological resources. Efforts on 112 of those acres were proactive, thereby clearing an entire area for future development without the cost or delay of just-in-time survey work. Additionally, various cemetery ground-penetrating radar surveys were conducted to define and map the boundaries of 28 pioneer era cemeteries, thereby protecting them against future development.

Naval Weapons Station Yorktown, Virginia

Naval Weapons Station (WPNSTA) Yorktown and its areas of responsibility contain 426 identified archaeological sites. The sites provide a unique look into the past, allowing a glimpse into the lives of American Indians and early Colonial settlers during the Revolutionary and Civil War eras, and onwards through the 18th, 19th and 20th centuries.

Over the past two years, WPNSTA Yorktown enhanced its commitment to cultural resources management through the implementation of its Integrated Cultural Resources Manage-

ment Plan to foster a balance between resource protection and operational requirements. Currently, the station is conducting investigations on four prehistoric sites. Through a cooperative agreement, the College of William & Mary has been evaluating archaeological deposits at Yorktown since 2011, which depicts an American Indian village dating to the period between AD 900 and 1623. This investigation has led to a large recovery of artifacts enhancing understanding of the historic village.

Environmental Excellence in Weapon System Acquisition

This award recognizes efforts to incorporate environmental, safety, and occupational health requirements into the system engineering, contracting, and decision-making processes of a large (Acquisition Category I) weapon system acquisition program. Adhering to these principles enhances DoD's acquisition process by ensuring that weapon system programs keep the safety of personnel and protection of the environment as a priority.

Large Program

P-8A Environmental, Safety, and Occupational Health (ESOH) Team, Patuxent River, Maryland

The P-8A acquisition program is committed to integrating environmental practices into the lifecycle management of its aircraft systems; this includes addressing issues such as engine air emissions, community noise, and hazardous materials use. The team working on the program is dedicated to ensuring timely deployments of P-8A aircraft that are compliant with federal, state, and local environmental laws and regulations. Strategic planning and execution by the team ensures that system-related environmental hazards are identified early in the lifecycle of the program and that best management practices are established and implemented throughout the lifecycle of the weapon system. By collaborating with Jacksonville Fleet Support Team, Naval Air Systems Command logistics personnel, and the manufacturer to optimize the P-8A Hazardous Material Authorized Use List (HMAUL), they reduced total HMAUL line items by 35 percent and decreased total items by 67 percent.

Afloat

The Afloat awards recognize outstanding contributions to fleet readiness, increased morale, and efficient, economical use of resources to promote environmental protection at sea.

Large Deck Combatant Category

USS Carl Vinson (CVN 70)

USS Carl Vinson and her crew of 3,100 Sailors operate in times of war as the cornerstone of joint/allied maritime expeditionary forces, supporting aircraft attacks on



Excavation of a ditch, fence, and hearth feature at the Kiskiak American Indian site on WPNSTA Yorktown, identified by the College of William & Mary Archaeological Field School.



Aviation Ordnancemen assigned to Patrol Squadron (VP) 16, prepare to load a MK-54 torpedo onto a P-8A Poseidon aircraft in Jacksonville, Florida. PMA-290 testing activities involve the use of underwater sound/explosives in the marine environment, including systems under development.
Eric A. Pastor

enemies, protecting friendly forces, and engaging in sustained independent operations.

USS Carl Vinson has a reputation for being the “greenest carrier in the Navy.” To prevent any inadvertent discharges of untreated sewage during transfer off the ship, the repair division completed 632 preventative and 54 corrective maintenance checks in FY15. When moored, discharge hoses to the pier were monitored hourly during shore transfers to enable duty personnel to secure pumping at a moment’s notice. This allowed for the transfer of 4.5 million gallons of sewage without any spills.

After returning from a ten month deployment in 2015, the vessel completed a tremendous amount of rehabilitation and maintenance work without any reportable environmental incidents. Daily inspections were conducted on equipment, and local experts were engaged to ensure

air pollution was minimized during work. One of the green improvements made was replacing 22 valves of the air conditioning and refrigeration center on refrigeration systems,

resulting in a 17 percent reduction in refrigerant releases to the atmosphere.

Littoral or Amphibious Warfare Category

USS Sentry (MCM 3)

USS Sentry is a mine countermeasures ship with approximately 80 crewmembers, forward deployed in Manama, Bahrain. In FY15, Sentry supported Operation Decisive Storm on only 72 hours’ notice. During the 60-day task, Sentry had many challenges surrounding the disposal of refuse. MCM class ships, unlike larger combatants, are not equipped with waste processing systems such as metal and glass shredders or plastic waste processing units. The Sentry’s culinary specialist devised methods to sort trash and garbage that allowed the crew to more easily dispose of biodegradable items, while holding plastics and paper waste until they could be properly disposed of during port visits.



Aircraft carrier USS Carl Vinson (CVN 70) transits the Pacific Ocean.
MCS3 Eric Coffey

The mine countermeasures ship USS Sentry (MCM 3) gets underway in Bahrain.

Martin L. Carey



During FY15, Sentry operated with the minimum number of engines necessary to support the ship's mission in order to minimize pollution and fuel consumption.

Military Sealift Command Category

USS Emory S. Land (AS 39)

USS Emory S. Land is a forward-deployed submarine tender whose primary mission is to provide intermediate maintenance repair to submarines and ships. Emory S. Land is manned by a crew of approximately 250 Sailors and 150 civilian mariners. The vessel is homeported at Diego Garcia, located in the British Indian Ocean Territory. In FY15, the submarine was underway for 64 days, and conducted six port calls.



The submarine tender USS Emory S. Land (AS 39) shortly after arrival to Fleet Activities Sasebo, Japan.

Michael Doan

Simply based on her assigned mission, Emory S. Land has a larger associated hazardous waste stream than most equivalently sized ships. The ship off-loaded as much as 40,000 pounds of hazardous material without any spills during port visits. The supply department took an aggressive approach by removing roughly 40,000 pounds of hazardous material to minimize its

use. Additionally, Freon was substituted with a more environmentally friendly refrigerant in compressors and air conditioning units.

The vessel's chaplain and 48 Sailors went the extra mile in FY15 by volunteering over 200 hours at several environmental community service events in Guam, the Philippines, and Oregon.

Surface Combatant

USS Chafee (DDG 90)

USS Chafee is homeported in Pearl Harbor, Hawaii, and houses 317 crew members and 30 Sailors. Chafee's policy is to always use the most fuel-efficient plant configuration to achieve operational requirements. The vessel made effective use of "drift ops" in order to reduce engine hours, fuel consumption and air pollution.

The Awards Process

THE ANNUAL CNO Environmental Awards program recognizes the environmental stewardship of installations, individuals, teams, and Navy ships. The CNO competition is the first level and all winners advance to the second Secretary of the Navy (SECNAV) level of competition along with U.S. Marine Corps submissions. Eligible SECNAV winners are selected to compete in the final Secretary of Defense level of competition among all the branches, with the exception of the afloat categories which are unique to the Navy levels of competition.



The Arleigh Burke-class guided-missile destroyer USS Chafee (DDG 90) transits the Philippine Sea.
Ricardo R. Guzman

During a 7-month deployment and multiple pre-deployment underway days, the crew found ways to secure main engines for 48 hours, saving over 100,000 gallons of fuel and reducing air pollution. Through judicious use of “drift ops” Chafee has limited her air emissions as much as possible, taking into account

operational commitments and safety of navigation.

Submarine Category

USS Tennessee (SSBN 734)

USS Tennessee, a ballistic missile submarine, is homeported in Kings Bay, Georgia, with a crew of 246 personnel. Tennessee leads the way

in environmental stewardship with an intense environmental training program. The crew completed over 1,500 man-hours of environmental awareness training in FY14 and FY15. Over the same time period, Tennessee ran 21 oil and hazardous material spill drills, ensuring all emergency response teams were properly trained to handle any acci-

dental discharges, and that Tennessee was able to load over 24,000 gallons of F-76 and lube oil without any incidents.

Aboard Tennessee, minimizing waste and hazardous materials is a priority. The use of disposable material is kept to a minimum. When disposables are needed, biodegradable products are utilized whenever possible. Most laundry detergents and cleaning chemicals on board are “green.” Additionally personnel use a first in/first out program in order to ensure that products are utilized before they expire, therefore reducing the volume of materials entering into the waste stream.

Congratulations again to all 29 of the FY 2015 CNO Environmental Award winners for their steadfast commitment to environmental excellence. [📍](#)

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The Ohio-class ballistic missile submarine USS Tennessee (SSBN 734) returns to Naval Submarine Base Kings Bay.
James Kimber

CNO Environmental Research & Development Programs Release Annual Reports

LMR Program Report & NESDI Year In Review Report Now Available

THE LIVING MARINE RESOURCES (LMR) program and the Navy Environmental Sustainability Development to Integration (NESDI) program have released their annual reports to highlight each program's accomplishments in fiscal year 2015 (FY15).

The LMR program and the NESDI program have released their annual reports to highlight each program's accomplishments in fiscal year 2015.

The LMR program addresses the Navy's key research needs and transitions the results and technologies for use within the Navy's at-sea environmental compliance and permitting processes. Its goals include improving marine species impact analysis (including marine mammal take

estimates), mitigation measures and monitoring capabilities. The FY15 report is the second for the relatively new program (formed in 2012) and includes a summary of the program's history, along with its mission statement, an explanation of the program structure and relative responsibilities of Navy research and monitoring programs, and an overview of how the LMR process works. The report provides brief updates on ongoing projects and partnerships, introduces new projects that were funded in FY15 and summarizes a project that was completed during the fiscal year. It also provides a list of 2015 publications that resulted from research either partially or fully funded by the LMR program.

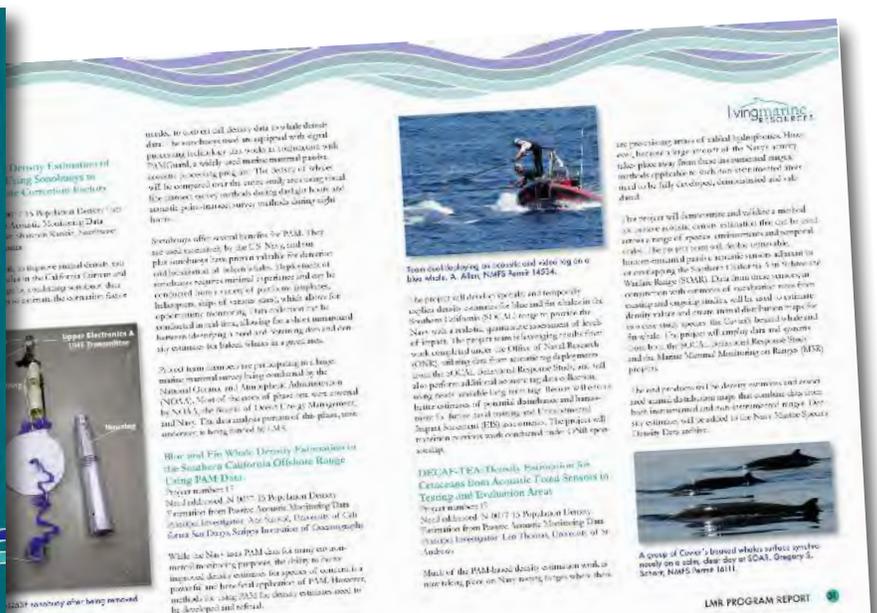
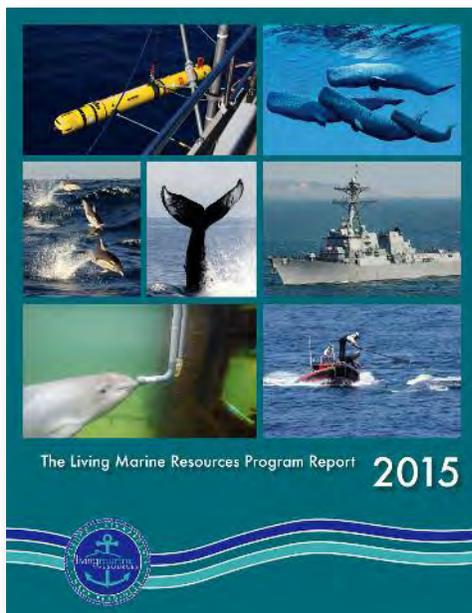
The LMR new start projects introduced in the FY15 report are:

■ **Project 13: Standardization of Auditory Evokes Potential (AEP) Audiometry Methods to Ensure Comparable Data Inclusion in a National Marine Mammal AEP Database**

Standardize hearing threshold measurement methods used in odontocetes (toothed whales) and increase species representation and sample sizes in hearing threshold estimates to reduce uncertainty in hearing range analyses used by Navy planners.

■ **Project 14: Behavioral Audiometry in Multiple Killer Whales**

Collect the first demographic hearing data from killer whales to understand how potential acoustic impacts



might vary within a mixed population of animals (across age and gender). Data from the study will help to determine mid-frequency cetacean composite audiograms and weighting functions for Navy at-sea environmental compliance.

- **Project 15: Jawphone Simulations to Maximize the Utility of Psychoacoustic and Auditory Evoked Potential Experiments**

Use a computational approach to identify the mechanism(s) by which jawphones (a suction cup containing a transducer) stimulate hearing when they are used to gather data on toothed whale auditory capabilities and formulate sensitivity maps as guidance for optimal placement of the jawphones to maximize their utility in gathering hearing data for a variety of animals.

- **Project 16: Passive Acoustic Density Estimation of Baleen Whales: Using Sonobuoys to Estimate Call-Rate Correction Factors**

Estimate baleen whale density in the California Current and the Navy's Southern California Offshore Range (SCORE) range by combining sonobuoy data with visual sightings to estimate the correction factor needed to convert call density data to whale density data.

- **Project 17: Blue and Fin Whale Density Estimation in the U.S. Pacific Fleet Southern California Offshore Range Using Passive Acoustic Monitoring Data**

Develop spatially and temporally explicit density estimates for blue and fin whales in the Southern California (SOCAL) range to provide the Navy with a realistic, quantitative assessment of levels of impact. Results will ensure better estimates of potential disturbance and harassment for future naval training and environmental impact statement (EIS) assessments.

- **Project 18: Acoustic Metadata Management for Navy Fleet Operations**

Expand development of Tethys, a passive acoustic monitoring metadata database, to improve its utility for long-term Navy monitoring data management and support Navy mitigation efforts.

- **Project 19: DECAF-TEA: Density Estimation for Cetaceans from Acoustic Fixed Sensors in Testing and Evaluation Areas**

Demonstrate and validate a method for passive acoustic density estimation that can be used across a range of species, environments and temporal scales.

Density estimates will be added to the Navy Marine Species Density Database.

- **Project 20: Behavioral Dose-Response Relationship and Temporary Threshold Shifts in Harbor Porpoises**

Establish a dose-behavior response relationship and determine sound exposure levels associated with temporary threshold shifts (TTS) and hearing recovery under varying sound exposures and conditions. Results will be used to update the criteria and thresholds for harbor porpoises

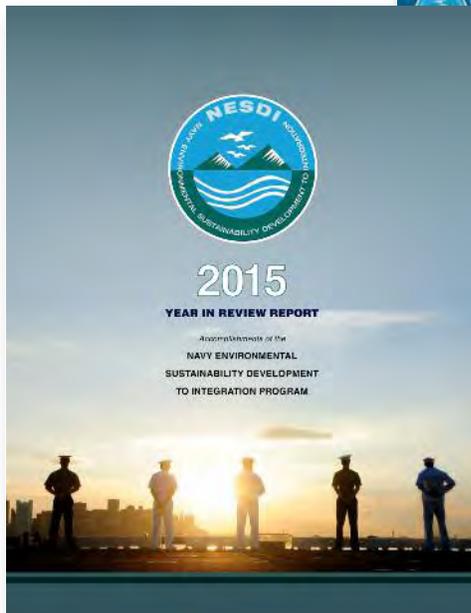
For More Information

FOR MORE DETAILS on the LMR program's FY15 investments, read our story "LMR Program Announces FY15 New Projects " in this issue of *Currents*.



The NESDI program's mission is to demonstrate, validate, and integrate innovative technologies, processes, and materials; and fill knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness. The program seeks to accomplish this mission through the evaluation of cost-effective technologies, processes, and materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The NESDI report profiles "new starts" for FY15 and discusses projects that were particularly successful over the course of the year in demonstrating the use of an innovative technology or integrating critical information to stakeholders across the Navy. Some notable accomplishments in FY15 include:



- **Project 465: Demonstration of Passive Samplers for Assessing Environmentally Realistic Concentrations of Munitions Constituents at Underwater UXO Sites**
Develop a passive sampler that detects ultra-low levels of constituents of concern with greater accuracy than any previous system.
- **Project 476: A Quantitative Decision Framework for Assessing Navy Vapor Intrusion Sites**
Develop a decision framework to help the Navy evaluate risk and remediation options at sites with vapor-phase contamination.
- **Project 485: Demonstrate and Validate Alternatives to Methylene Chloride-based Chemical Paint Strippers**
Demonstrate an environmentally friendly thixotropic paint stripper. A draft military specification is underway.
- **Project 492: Capacitive Deionization (CDI) Water Treatment System**
Develop a prototype system for treating drinking water at small facilities.
- **Project 495: Radioactive Material Permit Generation, Management, and Tracking System**
Develop a database that streamlines Radiological Affairs Support Office (RASO) operations and ensures compliance with environmental rules and regulations.
- **Project 506: Evaluation and Implementation of Compliance Options for NPDES Cooling Water Intake Structures at Existing Facilities**

Reduce the accidental intake of fish eggs and larvae into shipyard cooling water intake structures via a structural design modification that was accepted by the U.S. Environmental Protection Agency.

- **Project 509: Enterprise NAVFAC Hazardous Waste Application**
Develop a secure, web-enabled hazardous waste application that can be used by Naval Facilities Engineering Command installations worldwide.

Both the LMR and NESDI programs are sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Command. Electronic (pdf) versions of the LMR and NESDI reports can be downloaded from www.lmr.navy.mil and www.nesdi.navy.mil respectively. To obtain a hardcopy of either report, contact Lorraine Wass at 207-384-5249 or ljwass@outlook.com.

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NAVFAC Marianas Demonstrates Good Environmental Stewardship

Earth Month Events Contribute to Resiliency Ashore

IN CELEBRATION OF Earth Day in April 2016, Naval Facilities Engineering Command (NAVFAC) Marianas promoted resiliency ashore and demonstrated the Navy's commitment to improving the ecological health of the island of Guam through a variety of activities and month-long events.

During the week of April 11–15, NAVFAC Marianas leadership and personnel participated in the 7th Annual Center for Island Sustainability Conference hosted by the University of

Guam. Some took on speaking engagements, including Commanding Officer Captain Stephanie Jones, who was a panel speaker during the Western Pacific Subsection Water and Wastewater Conference. Others served as judges in the Green Dream Home Competition, a sustainable home design contest for local high school students.

NAVFAC Marianas also organized three Earth Month cleanup events on the island. Each event demonstrated the Navy's commitment to good environmental stewardship ashore by holding steadfast to sustainability and the protection and preservation of endangered species and federal properties.

"The Navy cares for thousands of acres of federal properties on Guam, and the way we do that is through an environmental management plan," said Mark

Bonsavage, NAVFAC Marianas Environmental Business Line Coordinator and Joint Region Marianas Environmental Program Manager. This environmental management plan details all of the programs in place that protect endangered species, the forest, and the ecosystem. According to NAVFAC Marianas Regional Environmental Coordinator Mark Cruz, this includes efforts to preserve animals, plants, cultural and archeological resources. "We do quite a few archeological, plant and animal surveys," said Cruz. "Once we identify those specific resources, we manage those areas by keeping the forests in good shape and managing the type of activities within the forest, around the beach or in the ocean."

The cleanups throughout April are designed to help improve Guam's ecological health, but environmental stewardship continues year round. "We take our responsibility to the environment seriously," said Carlo Unpingco, NAVFAC Marianas Earth Month Cleanup Activities Coordinator. "Our outreach supports the One Guam partnership; it's good for the wildlife. Besides, this is our home and the home of future generations." 📍



Sailors and volunteers pick up trash during an Earth Month Cleanup on April 23 at Tanguisson Beach Park in Dededo. NAVFAC Marianas hosted the cleanup to protect the environment and demonstrate the Navy's commitment to a One Guam and a Green Guam.

Leah Eclavea

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Building a Bridge to the Future

STEM Outreach at NAVFAC Northwest

PERSONNEL FROM THE Naval Facilities Engineering Command (NAVFAC) Northwest partner with local schools and participate in Science, Technology, Engineering, and Mathematics (STEM) outreach initiatives with an eye toward long-range sustainability.

Sustainability is core to the culture across the Pacific Northwest. NAVFAC Northwest's facility management for Navy Region Northwest exceeded goals set by the Energy Independence and Security Act of 2007 at all locations. The legislation called for a 30 percent energy reduction compared to a 2003 baseline and a 16 percent water reduction compared to a 2007 baseline. Northwest Navy installations produced a collective 39 percent energy reduction (with most facilities posting much higher gains) and 47 percent water reduction.

Northwest engineers and technicians employed a wide range of methods to meet and exceed the legislated sustainability goals. Just two examples:

1. Naval Station Everett installed smart meters which resulted in a 15 percent reduction in energy use.
2. Naval Base Kitsap introduced a new ground source heat pump system in two base housing structures. The system, combined with additional modernization efforts, upgrades and sustainable design improvements, resulted in a utility savings of over \$191,000 in fiscal year 2015.



Sierra used 'golf ball aerodynamics' to test the distance attained by a grape versus a raisin of the same weight. Shown with her is Mike Capuano, NAVFAC Northwest energy engineer.

Leslie Yuenger



Tabitha Pierzchala, Installation Energy Manager, viewed Cooper's project, a study of the 'play-ability' of a football with various pounds per square inch inflation.

Leslie Yuenger

On March 31, NAVFAC Northwest Sailors and energy, environmental, engineering, and environmental civilians participated in a science fair at Brownsville Elementary, a STEM-focused school in the local community. Students who gravitate to this line of study hold the promise to future improvements in the way the Navy manages its facilities. Many of the children at Brownsville Elementary have parents that work in science and engineering fields at local Navy commands.

School officials invite professionals from the community to participate in the annual science fair to give the students an opportunity to explain their projects to people they don't know, build upon their presentation skills, and encourage further development of the projects they presented. Navy representatives scored fifth and sixth grade science projects that were presented on electronic devices that save the students' work in "the cloud." Students were graded on how well they followed the scientific method and demonstrated a firm understanding of their subject matter. They were also evaluated on imbedded videos and other aspects of their presentation.

Topics of the science projects show that many students have an interest in subjects related to energy and the environment. One student conducted experiments to determine whether potatoes generate more sustained electricity when cooked, refrigerated, or left at room temperature. Another student lowered dry batteries that he constructed from aluminum foil and paper towels into various liquids to see which combination would generate the most electricity.

Another tested the effect of different liquids on the time required to sprout plant seeds.

This year Brownsville Elementary also hosted a STEM open house. Navy representatives provided and manned an energy table at the event, where they educated children and parents about Navy accomplishments in energy and water management, and provided energy and water saving tips.

Attracting the next generation of scientists and engineers to apply their young technical minds to Navy goals is vital to future operations. NAVFAC Northwest engineers are reaching out to local schools, showing potential scientists and engineers of the future what the Navy is doing today to enhance sustainability.

NAVFAC Northwest is responsible for maintaining and modernizing more than 15 million square feet of facilities at naval installations in the Pacific Northwest. The installations, all located in Washington State, are: Naval Base Kitsap, which has sites in Bremerton (including Puget Sound Naval Shipyard & Intermediate Maintenance Facility), Bangor, Keyport, Manchester Fuel Depot, and Naval Magazine Indian Island; Naval Air Station Whidbey Island; and Naval Station Everett. 

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Tell Your Story in *Currents* • Deadline for Winter 2016-17 Issue is October 21, 2016

Have some good news about your energy or environmental program? Want to share it with others? *Currents* is the place to do it. *Currents*, the Navy's official energy and environmental magazine, has won first place in the Navy's Chief of Information (CHINFO) Merit awards competition three times. Most recently, the magazine snagged an honorable mention in the last CHINFO competition. Its people like you and the stories you submit that make *Currents* the best magazine in the Navy.

So if you have a story that you'd like us to promote in our winter 2016-17 issue, submit your text and images by Friday, October 21, 2016. Any submissions received after this date will be considered for our spring 2017 issue.

You can get a copy of the *Currents* article template by sending an email to Bruce McCaffrey, our Managing Editor, at brucemccaffrey@sbcglobal.net. This template has proven to be a tremendous asset in helping us edit and track your article submissions. Bruce is also available at 773-376-6200 if you have any questions or would like to discuss your story ideas. And don't worry. If writing isn't one of your strengths, we'll handle all of the editing necessary to get your submission into publishable form.

As a reminder, your Public Affairs Officer must approve your article before we can consider it for inclusion in the magazine.

Don't forget to "like" us on Facebook at www.facebook.com/navycurrents. *Currents'* Facebook page helps expand the reach of the magazine and spread the news about all the great work you're doing as the Navy's energy and environmental guardians

Currents Deadlines

Winter 2016-17 Issue: Friday, October 21, 2016
 Spring 2017 Issue: Friday, January 20, 2017
 Summer 2017 Issue: Friday, April 21, 2017
 Fall 2017 Issue: Friday, July 21, 2017

You can also refer to your *Currents* calendar for reminders about these deadlines.

Currents Magazine's History of Awards

2014	Russell Egnor Navy Media Award	Honorable mention in "Funded News Publication" category
2011	CHINFO Merit Award	First place medal ("Best magazine in the Navy")
2008	CHINFO Merit Award	First place medal ("Best magazine in the Navy")
2004	CHINFO Merit Award	First place medal ("Best magazine in the Navy")
2004	Department of Defense Thomas Jefferson Award	First place medal ("Best magazine in the Department of Defense")
2003	CHINFO Merit Award	Second place medal
2001	CHINFO Merit Award	Third place medal

Warfare Centers, Industry Meet for High Energy Storage Conference

Professionals Focus on Safe, Affordable Batteries & Other Energy Sources

A RECENT SUMMIT in Newport, Rhode Island provided an opportunity for Navy energy storage professionals to discuss the future of affordable energy storage in the Navy.

From May 24–26, 2016, the Naval Undersea Warfare Center (NUWC) Newport hosted the third Naval Energy Storage Summit. Attendees included various Navy and Department of Energy personnel along with industry experts specializing in energy storage technology.

NUWC Newport's Technical Director Mary Wohlgemuth introduced the guest speakers.

Presenters included Mr. Joseph Bryan, Deputy Assistant Secretary of the Navy (DASN) Energy; Dr. Edward Ammeen, Director of Marine Engineering, Naval Sea Systems Command (NAVSEA); Dr. Tim Arcano, Technical Director, Naval Surface Warfare Center (NSWC)

Carderock; and Joseph Vignali, NAVSEA Marine Engineering.

The goal of the summit was to provide an opportunity for the Navy's energy subject matter experts to discuss the future of energy storage affordability in the Navy. "It's all about commonality and making energy storage safe, reliable, and affordable," said Wohlgemuth.

The Navy needs advanced energy storage devices to enable a wide range of capabilities in the air, at sea, and on land. Unmanned systems, including those intended to ensure U.S. Navy underwater dominance, encompass a large number of these applications. Energy storage is an enabling capability for many ship-board systems as well.

Mr. Joseph Bryan, the Secretariat focal point for all matters pertaining to the Department of Navy (DON) energy initiatives, gave the first presentation,

"Energy Storage Commonality and Perceived Cost Benefits." Bryan spoke about the Great Green Fleet and alternative energy sources as well as the safety and commonality issues of lithium ion batteries.

"We spend a lot of time thinking about the challenges of energy storage," said Bryan. "We need to identify opportunities to improve safety and reduce costs."

Dr. Ammeen's presentation was focused on systems safety from the NAVSEA perspective. "NAVSEA is responsible for lithium ion battery safety across the Navy," said Ammeen. "We have to start early with safety certification planning for testing and assessments. There are more high energy power systems coming online. We need to develop a strategic and comprehensive process to address the growing need for advanced energy storage systems."

*We spend a lot of time thinking about the challenges of energy storage.
We need to identify opportunities to improve safety and reduce costs.*

—Mr. Joseph Bryan



Joseph Bryan, DASN Energy, kicked off the summit.
Richard Allen



Dr. Tim Arcano, Technical Director, NSWC Carderock.
Richard Allen



Dr. Joseph Fontaine, Undersea Vehicles Propulsion and Energy Branch Chief, NUWC Newport (left) and Joseph Vignali, NAVSEA Marine Engineering (right).
Richard Allen

With one of the key focus areas of Safe Common Affordable Power & Energy Storage (SCAPES), Dr. Arcano's presentation addressed the issues of commonality. He noted some of the challenges facing NAVSEA in regard to energy storage: the greater need for higher energy density, the proliferation of unique battery solutions, and the cost and time associated with certification.

"DASN (RDT&E) and DASN (Energy) called for the development of a plan to create a family of common lithium batteries to reduce acquisition, schedule, and cost," said Arcano.

As the signing authority of NAVSEA's safety certification memos, Mr. Vignali focused his brief on the safety challenges of high-energy storage systems. A single high-energy powered system (such as an unmanned undersea vehicle) is likely to require multiple certifications to cover varying users and host/platform environments. Vignali and his colleagues are working with the Systems Commands to ensure safe operations on all naval platforms.

For more than a decade, NUWC Newport has been researching fuel cells—both solid oxide fuel cells and proton exchange membrane fuel cells—both of which can produce an electric current directly from a chemical reaction. These fuel cells can be used to power vehicles such as underwater vehicles used for data collection. NAVSEA Marine Engineering recently started drafting technical instructions and requirements for their use in the Fleet.

"We're doing a lot of energy research at NUWC Newport so it was a good fit for us to host this summit. It gives us an opportunity to align what we're doing with the needs of the Navy," said Dr. Joseph Fontaine, head of the Undersea Vehicles Propulsion and Energy Branch at NUWC Newport. "Having many of the stakeholders together over several days also keeps us connected and maintains the working relationships necessary for getting products out to the Fleet." 

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SERDP & ESTCP Announce 2015 Projects of the Year

Notable Efforts Include Research on Lighting Controls That Save Energy & Reduce Costs

THE STRATEGIC ENVIRONMENTAL Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP) have selected nine Projects of the Year in recognition of outstanding research and technology developments that will benefit the U.S. Department of Defense (DoD). These efforts are helping DoD enhance its mission capabilities, improve its environmental performance, and reduce costs. The following are recipients of this honor and descriptions of their award winning projects. Additional information is available at www.serdp-estcp.org.



Energy and Water ESTCP Project of the Year

Dynamic Exterior Lighting for Energy and Cost Savings in DoD Installations

*Dr. Satyen Mukherjee
Philips Research, a division of
Philips Electronics North America
Corporation*

Exterior lighting accounts for nearly ten percent of the electricity consumed at DoD military installations. Many of the existing exterior lighting systems use inefficient high pressure sodium or metal halide lights that are controlled with photosensors, which turn lights on regardless of



Dynamic lighting controls have the potential to reduce DoD's energy usage and provide significant cost savings.

usage patterns. Dr. Satyen Mukherjee of Philips Research and his team demonstrated that military installations can achieve significant electricity savings, by implementing efficient light emitting diode (LED) lighting sources and smart lighting controls.

The project evaluated three exterior lighting applications at U.S. Army Base Fort Sill, Oklahoma:

1. Dynadimmer for parking lots
2. Starsense for street lighting
3. Lighting on Demand for maintenance areas

Dynadimmer is a standalone fixture-by-fixture control architecture that uses a preprogrammed dimming profile integrated in the LED driver to reduce the light levels during periods of low occupancy. Starsense is a radio frequency mesh-networked system in which each light fixture is controlled independently using an outdoor lighting controller added to each LED fixture. The Lighting on Demand system couples the Starsense mesh network with motion detection sensors, allowing dynamic adaptive control of the light levels in each fixture.

Advanced controls with LED light sources reduced energy consumption for exterior lights by 60 to 90 percent depending on the application. These energy savings were achieved while also improving the quality of light in terms of color rendering and brightness. In all three systems, the lighting levels measured in the demonstrations exceeded Illuminating Engineering Society of North America illumination requirements.

The DoD could use efficient LED lighting sources and smart controls to achieve significant energy savings and improve illumination in exterior lighting applications at their military installations across the country.

Environmental Restoration ESTCP Project of the Year

Development and Validation of a Quantitative Framework and Management Expectation Tool for the Selection of Bioremediation Approaches at Chlorinated Solvent Contaminated Sites

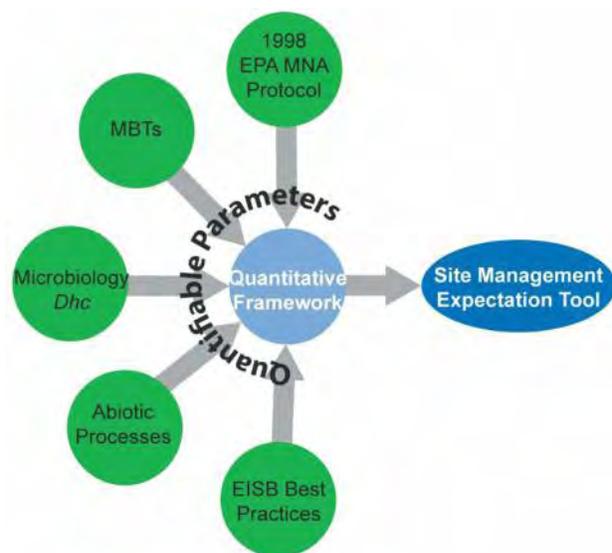
Ms. Carmen A. Lebrón, Private Consultant (formerly of the Naval Facilities Engineering and Expeditionary Warfare Center)

Chlorinated solvents are the most prevalent groundwater contaminants, with an estimated 15,000 to 25,000 conta-

minated sites in the United States. Naturally-occurring biological and abiotic processes contribute to contaminant attenuation in most hydrogeological systems, including contaminated aquifers. Over the years, monitored natural attenuation (MNA) and enhanced bioremediation have become common remedial approaches. At sites where natural processes alone are sufficient to meet site-specific remediation goals, MNA is implemented as the most cost-effective remedy. At sites where MNA is not sufficient to meet remediation goals, it may be necessary to enhance biological and/or abiotic degradation processes to jump start natural attenuation.

Ms. Carmen Lebrón and her team developed BioPIC, a systematic approach and management expectation tool for determining if MNA, biostimulation, and/or bioaugmentation will be the most appropriate remedy, based on site-specific conditions at contaminated groundwater sites. BioPIC uses the quantitative relationships among biotic and abiotic parameters that contribute to the degradation of chlorinated ethenes to assist a user in determining the best pathway to selectively enhance degradation. The tool allows the user to confirm degradation and subsequently aid in the determination of the relevant degradation pathway(s) based on the assessment of specific analytical parameters.

This pragmatic approach will generate comprehensive and defensible remediation strategies, as well as reduce both capital and operation and maintenance costs for groundwater remediation. It can also minimize potential environ-



BioPIC provides an approach for determining the most appropriate remediation strategy based on a site's specific conditions.

mental impacts of more invasive bioremediation treatment options. Overall, BioPIC will aid remediation project managers in evaluating and selecting the most appropriate biologically-mediated remediation strategy for a given chlorinated-solvent contaminated site.

Resource Conservation and Climate Change ESTCP Project of the Year

Aerial Application of Acetaminophen-Treated Baits for Control of Brown Tree Snakes

Dr. Brian S. Dorr

U.S. Department of Agriculture's (USDA) National Wildlife Research Center

Infestations of the brown tree snake (*Bioga irregularis*) have led to the extirpation of all but two of the 12 native forest birds on the island of Guam. In addition, the snakes have caused millions of dollars in damage to the island's electrical power distribution system. An anticipated increase in the U.S. military presence on Guam will increase the flow of outbound cargo that could overtax the present operational control methods, such as trapping, hand capture, and canine inspection of outbound cargo; which deter the spread of snakes from Guam to other locations that are conducive to the snake's habitat, including Hawaii.

An ESTCP-funded project led by Dr. Brian Dorr from the USDA's National Wildlife Research Center demonstrated an aerial control method deploying dead neonatal mice baits treated with acetaminophen, which is toxic to the snakes, in order to reduce snake populations in forested sites on Guam. The treated mice were individually attached to four-foot-long paper flag streamers and deployed by hand from helicopters. The baits entangle the treated



An ESTCP-funded project has developed a methodology to combat the brown tree snake infestation on the island of Guam.

USDA Wildlife Services

mice in vegetation above ground level, where they can be consumed by brown tree snakes. Some of the mice were implanted with a radio transmitter for tracking purposes.

This demonstration resulted in a significant and sustained reduction in the indices of snake numbers at the demonstration sites. The team is now working to develop an automated bait delivery system, which will provide for rapid bait release and reduce overall delivery costs.

Weapons Systems and Platforms ESTCP Project of the Year

Demonstration/Validation of Zinc-Nickel as Replacement for Cadmium/Cyanide Plating Process for Air Force Landing Gears

Mr. David Frederick

417th Supply Chain Management Squadron (SCMS), U. S. Air Force (USAF) Landing Gear Team

Replacement of cadmium plating in aircraft landing gear manufacturing and maintenance is a high priority for

the DoD. Military aircraft maintenance depots use cadmium plating extensively to apply corrosion resistant coatings to various high-strength steel aircraft components during manufacture, repair, and overhaul. Wastes generated from these plating operations must abide by strict U.S. Environmental Protection Agency (EPA) emissions standards and Occupational Safety and Health Administration permissible exposure limits. The operational costs to comply with these rules and the increased turnaround times for processing of components require DoD to find an environmentally benign alternative to cadmium.

Mr. David Frederick of the 417th SCMS, USAF Landing Gear Team, and his team demonstrated the use of low hydrogen embrittlement (LHE) zinc-nickel (Zn-Ni) for a wide variety of applications. The LHE Zn-Ni meets or exceeds all acceptance criteria for coating quality, adhesion, fatigue, corrosion, and hydrogen embrittlement. Based on test results and in-field performance tracking, LHE Zn-Ni

has been implemented within the Air Force overhaul facility and is being adopted by industry as an alternative to cadmium plating. Under the ESTCP-funded project, Hill Air Force Base has processed more than 1,000 landing gear components using LHE Zn-Ni. Some of these components have been flying on aircraft for the past three years. Numerous commercial entities have tested and accepted LHE Zn-Ni, and installed LHE Zn-Ni plating lines following the USAF lead. In addition, several DoD maintenance depots are exploring the utility of Zn-Ni plating based on the success of this project.

and is a common constituent in rockets, mortars, grenades, and Howitzer rounds. In addition to lead, a number of other potentially toxic trace metals and metalloids are of concern. Bullet alloys generally include antimony, arsenic, bismuth, and silver; copper or nickel jacket commonly form bullet casings. Fragments of bullets and other munitions debris are highly susceptible to oxidation and weathering processes in soil systems, leading to the release of aqueous metal or metalloid species into soils. The potential for metals or metalloids stored in soils to migrate from ranges into surface or subsurface aquatic systems is a human health and environmental concern.



This ESTCP project demonstrated the use of LHE Zn-Ni coatings as viable alternatives to electroplated cadmium.

Dr. Thomas Trainor of the University of Alaska Fairbanks and his team have conducted an in-depth analysis of the changes in lead and antimony speciation that occur over time in range soils. They constructed shooting range impact berms to observe the progression of metal oxidation and track the evolution of mobile species that form as a result of fragment weathering processes, under field conditions. Through this effort, they determined the efficacy of soil amendments to reduce metal and metalloid mobility and developed surface-specific analytical tools to complement traditional geochemical analytical methods. The team is now completing studies that will further the understanding of the factors that control the mobility and speciation of lead and antimony in soils, that enhance the use of passive sensors and surface-specific speciation methods, and that test promising remediation scenarios, based on cost-effective chemical amendments to the soils.

The LHE Zn-Ni coatings for military aircraft landing gear that were successfully demonstrated and transitioned by this project will help eliminate environmental and worker safety concerns associated with cadmium used in DoD plating operations.

Environmental Restoration SERDP Project of the Year

Lead and Antimony Speciation in Shooting Range Soils: Molecular Scale Analysis, Temporal Trends, and Mobility

*Dr. Thomas Trainor
University of Alaska Fairbanks*

Soil contamination is a concern at many firearms training facilities. Lead is the primary metal of concern, as it makes up approximately 90 percent, by mass, of a typical bullet

and that test promising remediation scenarios, based on cost-effective chemical amendments to the soils.

The results of this study have improved the understanding of lead and antimony mobility through range soils. This comprehensive understanding of the processes controlling mobilization versus retention of species, associated with bullet fragment weathering in small arms training range soils, is essential for assessing long-term environmental risk, for understanding the efficacy of remediation scenarios, and for identifying what materials to incorporate into future training range or impact area designs. This work will lead to technical guidance for remediation program managers and regulators to monitor geochemical conditions pertinent to weathering of munitions constituents in soils and surrounding environments.

Munitions Response SERDP Project of the Year

Continuous Monitoring of Mobility, Burial, and Re-Exposure of Underwater Munitions in Energetic Near-Shore Environments

*Dr. Peter Traykovski
Woods Hole Oceanographic Institution*

Long Time Series Measurements of Munitions Mobility in the Wave-Current Boundary Layer

*Dr. Joseph Calantoni
Naval Research Laboratory*

Assessing and predicting the burial, mobility, and re-exposure of underwater munitions is an important component of the management and potential remediation of underwater munitions sites. Munitions from former or active DoD installations may migrate underwater or to the near-shore environment and become re-exposed, which would

pose human safety concerns. Multiple DoD research efforts are working to improve understanding of the hydrodynamic mechanisms that drive munitions burial and mobility, and current research aims to quantify these forces within parameterized models.

Dr. Traykovski and his team at Woods Hole Oceanographic Institution approached this problem by collecting field measurements on munitions in the highly energetic, sandy, near-shore environment of Long Point, Massachusetts. Continuous measurements were obtained using in-situ rotary sidescan sonar and an ultra-short baseline acoustic tracking system. They found that the migration of munitions was highly dependent on sandwave migration, munitions density, and storm event strength. By collecting high quality data sets and developing foundational models, Dr. Traykovski has provided a baseline for understanding the factors that influence munitions migration and set the standard for future research.

Dr. Calantoni and his team at the Naval Research Laboratory deployed equipment to record in-situ time-series measurements of boundary layer processes responsible for munitions mobility while simultaneously monitoring the mobility of surrogate munitions. They obtained sector scanning sonar imagery measurements within a highly energetic, sandy environment at Duck, North Carolina, and Panama City Beach, Florida. The project team observed munitions burial at multiple water depths (6 meters (m) and 8 m) and incorporated these observations into analyses of horizontal and lateral munitions mobility. These datasets provide information that will be used to verify and validate existing mobility models and develop new conceptual models for fate and transport of munitions. The data collected for this study highlight the role of hydrodynamics, near-shore bathymetry, and munition density in determining the mobility of munitions.



Dr. Calantoni and his team deployed their equipment to record in-situ time-series measurements of boundary layer processes responsible for munitions mobility.

Resource Conservation and Climate Change SERDP Project of the Year

Hydroecology of Intermittent and Ephemeral Streams: Will Landscape Connectivity Sustain Aquatic Organisms in a Changing Climate?

*Dr. Julian D. Olden
University of Washington*

*Dr. David A. Lytle
Oregon State University*

Intermittent and ephemeral streams play a significant role in supporting the ecological diversity in the south-



The ecological information on ephemeral and intermittent stream ecosystems obtained by this project will help DoD managers better conserve the biodiversity in this region.

western United States. Long-term use of military installations and ranges in this region is, in part, dependent on the ability to maintain the continued ecological functioning of the land base in this region, where dryland streams provide critical habitat and population connectivity for obligatory aquatic species. Improvements in the fundamental understanding of the links between hydrologic and ecological processes in arid and semi-arid environments will aid resource managers in the proactive conservation of species at risk and their habitats on and around DoD installations.

A SERDP-funded project led by Dr. Julian Olden of the University of Washington and Dr. David Lytle of Oregon State University examined how hydrology, hydrologic connectivity, and other riverine characteristics influence the community structure and population genetics of amphibian and aquatic insect species on Fort Huachuca,

Arizona, and in the surrounding Sky Island mountain ranges. By employing field studies, quantitative modeling in relation to hydrology, riparian vegetation, geomorphology, and innovative molecular genetics, the project team quantified stream characteristics at multiple spatial scales and showed how aquatic species with different life-history strategies respond to dryland stream ecosystems in the Southwest.

This project provided key ecological information on ephemeral and intermittent stream ecosystems that contain most of the biodiversity in the southwestern United States and for which DoD has significant management responsibility. These results will not only help DoD managers better conserve this biodiversity today, but also in the future under a changing climate.

Weapons Systems and Platforms SERDP Project of the Year

Novel Coatings Systems for Use as High Performance Chemical Agent Resistant Powder Topcoats

Mr. Mark J. Wytiaz

The Sherwin-Williams Company

Chemical Agent Resistant Coatings (CARC) are used by DoD for the protection of military assets. Current solvent-borne and water-dispersible CARC topcoats contribute approximately 2.3 million pounds of volatile organic compounds (VOC) and hazardous air pollutants to the environment each year. For decades, DoD has recognized the need to develop powder coatings, which contain no solvents, as a means to greatly reduce these emissions. The key challenges to developing powder coatings for CARC topcoats are achieving chemical warfare agent resistance, extremely low gloss, and superior exterior durability.

Mr. Mark Wytiaz of Sherwin-Williams and his team established a fundamental understanding of coatings materials and their interactions, which led to the successful development of a CARC powder topcoat technology. They produced topcoats in Tan 686, Green 383, and Black 37030, which together represent nearly 95 percent of the military's needs. The new CARC coatings use blends of incompatible resins, formulated with low loadings of highly efficient fillers and pigments that are key to meeting the low-gloss requirement.

The three CARC powder topcoats have been or are being qualified against the military specification requirements for



This micrograph shows the novel resins used to formulate new chemical agent resistant powder coatings.

listing on the Qualified Products Database. Field trials verified coating performance and validated the success of the project. Coatings products are currently in transition to original equipment manufacturers, maintenance depots, and the Defense Logistics Agency.

These innovative powder coatings offer the benefits of a technology that is absent of solvent, emits nearly zero VOCs, can be recycled, and is compatible with existing CARC systems. In addition, testing to-date proves that the exterior durability of this coating is superior to any liquid CARC system, supporting DoD's initiative for corrosion prevention and mitigation.

About SERDP & ESTCP

SERDP and ESTCP are DoD's environmental research programs, harnessing the latest science and technology to improve DoD's environmental performance, reduce costs, and enhance and sustain

mission capabilities. SERDP and ESTCP respond to environmental technology requirements common to all of the military Services, complementing the Services own research programs. The programs promote partnerships and collaboration among academia, industry, the military Services, and other Federal agencies. Investments are managed in five program areas:

1. Energy and Water
2. Environmental Restoration
3. Munitions Response
4. Resource Conservation and Climate Change
5. Weapons Systems and Platforms

SERDP and ESTCP are independent programs managed from a joint office to coordinate the full spectrum of efforts, from basic and applied research to field demonstration and validation.

SERDP is DoD's environmental science and technology program, planned and

executed in partnership with the Department of Energy and the EPA, with participation by numerous other Federal and non-Federal organizations. The program focuses on cross-service requirements and pursues solutions to the Department's environmental challenges while enhancing and sustaining military readiness.

ESTCP is DoD's environmental technology demonstration and validation program. Project researchers conduct formal demonstrations at DoD facilities and sites in operational settings to document and validate improved performance and cost savings. Demonstration results are subject to rigorous technical reviews to ensure that the conclusions are accurate and well supported by data.

For more information, visit www.serdp-estcp.org.

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Currents 2016–2018 Calendar Is Bigger & Better Than Ever

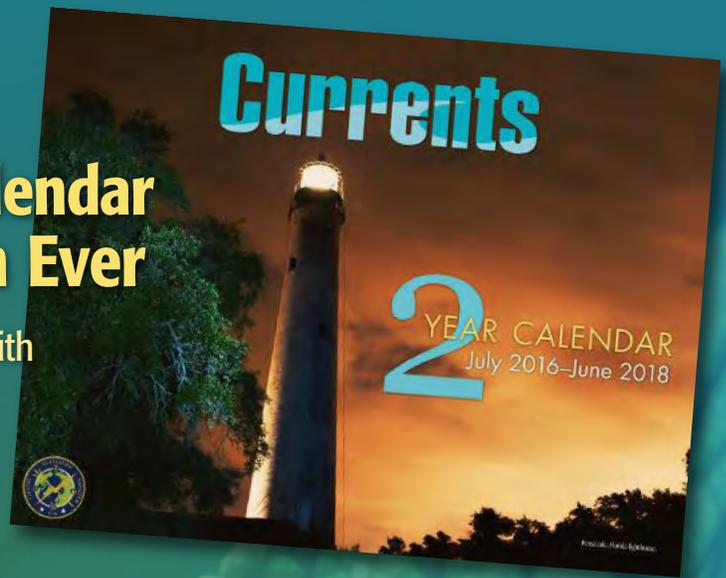
24-Month Calendar Has You Covered with 22 Awards & Earth Day Highlights

For the latest *Currents* calendar, we have expanded the format to 24 months to encompass the great work by winners in a full suite of Secretary of the Navy (SECNAV) Environmental and Energy and Water Management award categories. We also added Earth Day history and highlights.

Your new calendar begins in July 2016 with the Marine Corps Expeditionary Unit category of the Energy and Water Management awards. The team at Twenty-nine Palms has trained tens of thousands of Marines in energy efficiency procedures and has reduced petroleum use.

The calendar presents a different award category each month, alternating between the Environmental and Energy and Water award programs. Two aviation categories—Naval Air Force Atlantic and Naval Air Force Pacific—were recently added to the Energy and Water awards and we have them covered. Examples of topics in other months include:

- August 2016: Two winners of the SECNAV Environmental award for Cultural Resources Management (small installation): Portsmouth Naval Shipyard (Maine) and Marine Corps Base Hawaii



- February 2017: Large ship category of the Energy and Water awards was won by USS Bonhomme Richard (LHD 8)
- April 2017: Senator Gaylord Nelson's role in Earth Day history

As the Navy's official energy and environmental magazine, *Currents* has the privilege to share the many ways the Navy's energy and environmental personnel, Sailors and Marines work to find and implement the best techniques to achieve their goals. *Currents* provides a forum in which all of you can share your knowledge and successes with your colleagues.

If you subscribe to *Currents* magazine you should have received your 2016–2018 calendar by now. If not, please contact Lorraine Wass, our distribution manager, at ljwass@outlook.com to receive your own copy. You will also be able to find the calendar, and issues of the magazine, online at <http://greenfleet.dodlive.mil/currents-magazine>.



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