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Naval Submarine Medical Research Laboratory Groton, CT

The United States Submarine service has a long and proud tradition of developing and operating with leading edge technologies. The Naval Submarine Medical Research Laboratory (NSMRL) is a major contributor to integrating these technologies into submarine crew operations. NSMRL is DoD's Center for Undersea Biomedical Research. The laboratory's mission is to protect the health and enhance the performance of warfighters through submarine, diving and surface biomedical research solutions. Established in World War II to conduct mission critical studies in night vision, sonar sound discrimination, and personnel selection, NSMRL continues to serve the fleet by taking the lead in undersea human factors, sensory sciences and operational medicine.

Located on Submarine Base New London, Groton, CT, NSMRL researchers have access to three submarine squadrons in Submarine Group Two; the Navy Submarine School; the Naval Submarine Support Facility; Naval Undersea Medical Institute; and the Electric Boat Division of General Dynamics, which builds the nation's submarines. The laboratory is staffed by a diverse group of psychologists, audiologists, physicians, physiologists, and electrical, biomedical and nuclear engineers. Several colleges and universities are located in the same area, including the US Coast Guard Academy, Connecticut College, and the University of Connecticut.

NSMRL's accomplishments continue to be many and varied, and include scientifically based recommendations for submarine rescue procedures, submarine atmosphere limits, waivers for clinical medical conditions, advanced sonar system capabilities, diver/sonar safe distances, and symbology for visual displays.

NSMRL Scientists and Divers Touched by History



preparation project. This is a good example of Navy scientists and divers working side-by-side with working dive lockers and other government agencies to accomplish both research data collection and provide direct fleet support.

A research team of scientists and divers dove into history when they collected research data as part of a preservation project for the USS ARIZONA memorial in Pearl Harbor, HI. The team worked with Mobile Diving and Salvage Unit 1 and the National Park Service, taking underwater noise measurements of a new hydraulic tool designed to remove samples of the battleship's hull for metallurgical analysis. The research team had two jobs to do, collect underwater noise levels as part of NSMRL's two-year comprehensive in-water noise survey project and determine the on-site permissible noise exposure level for the divers. Team members also performed working dives to assist in completion of the

Diving and Environmental Simulation Department

- The Diving and Environmental Simulation Department focuses on ways to optimize the safety and performance of Navy divers by investigating diver performance for a variety of environmental factors including sound exposure, thermal stress, and breathing gas conditions. Underwater noise can impact a diver through damage to hearing and internal organs, such as the lung and brain. Applied research includes reducing workplace hazards, providing underwater noise-protection tools and developing underwater force protection. A critical part of the program is the on-going direct fleet support regarding guidelines for operational limits due to underwater noise and direct support of the U.S. Navy's Force Protection efforts in diver deterrence/protection. These guidelines are developed directly from the basic research data collected by the laboratory.

Submarine Medicine & Survival Systems Department

- Submarine Medicine researchers focus on ways to optimize the health and job performance of undersea warfighters and reduce attrition and health impact due to psychological and physical conditions. The department includes the NAVSEA-sponsored Submarine Atmosphere Health Assessment Program.
- Survival Systems researchers conduct basic and applied research and development in the biomedical and bioengineering aspects of submarine casualties by developing equipment, procedures and guidance to optimize submarine disaster survival. The researchers serve as subject-matter experts on submarine rescue and escape for the operational fleet, policy makers and industry.

Human Performance Department

- Determining the operational viability of alternative watchstanding schedules for submariners could provide a biologically-based, circadian-friendly work/rest regimen that enhances alertness and performance while improving sleep efficiency. A study on an underway nuclear submarine will directly compare the alternative schedule's advantages over the current submarine watchstanding schedule, and what operational practices require modification to accommodate it.
- Hearing conservation focuses on ways to identify the early stages of noise-induced damage to the human ear to prevent noise-induced hearing loss (NIHL). Current research evaluates new methods to evoke otoacoustic emissions, an objective test considered sensitive to the early stages of—and susceptibility to—NIHL. The team's approach is to evaluate these methods in the laboratory for obtaining valid, reliable, and sensitive estimates of temporary noise-induced changes, and in the field using noise-exposed, at-risk personnel for detecting the early stages of permanent NIHL. The team also seeks to estimate the payoff from preventing hearing loss, by modifying the design of high-noise equipment and weapons, and in simulating the effects of NIHL on everyday activities.
- Ongoing research is developing unique auditory sonar displays that effectively double the distance of target detection by using the powerful technique of comparing interaural information, through novel beamforming techniques applied to existing hardware. Scientists also seek to optimize the quality of information presented to Navy submariners by creating an accurate, three-dimensional auditory representation of the undersea environment, and developing active noise-canceling binaural headphones. Combined, these display improvement strategies will help operators separate important from irrelevant information, reducing workload, and improving the identification, classification, and tracking of signals of interest, thereby elevating Situation Awareness.

Achievements:

- Sea Lab I undersea habitat project
- Development of the International Orange Color (Air-Sea Rescue Red)
- Disabled Submarine Escape and Rescue project
- Saturation diving and decompression tables
- Hearing conservation in noisy environments
- Safe exposure guidance for personnel in the presence of intense low and high frequency sonars
- Enhanced underwater target detection and localization
- Studies of nitrogen narcosis
- Effects of atmospheric constituents on health and performance in enclosed environments
- Pressurized Submarine Rescue Manual
- Data-based medical qualification policies
- Farnsworth lantern for screening color vision
- Underwater acoustic signal discrimination and classification
- Hearing loss modeling