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Environmental Updates

Highlights of Battelle's International Environmental Leadership

Fall 2004

ENVIRONMENTAL SECURITY

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Aquatic Nuisance Species: A Global Environmental Threat

Non-indigenous species introductions have been cited as the second greatest threat to biodiversity behind habitat loss and are recognized by conservation biologists as the second most serious threat to endangered species after habitat destruction. The introduction of non-indigenous aquatic nuisance species (ANS) to coastal areas around the world has had profound negative impacts on aquatic ecosystems worldwide and is considered one of the most important issues facing the maritime community. In the United States, the introduction of ANS has altered important ecological processes and caused serious economic damage.

The discharge of ship ballast water is a major vector for the introduction of ANS, transporting more than 7,000 species daily. Ballast water is water taken aboard vessels to maintain stability and vessel safety. Globally, 3 to 5 billion metric tons of ballast water are discharged annually. This global transport of ballast water has led to problems such as displacement of native freshwater species and the alteration of the food web by *Dreissena polymorpha* (Eurasian zebra mussels) in the Great Lakes, and the Mississippi and Hudson Rivers, decimation of the anchovy industry in the Black and Azov Seas by *Mnemiopsis leidyi* (American comb jelly), and introduction of the north Pacific sea star *Asterias amurensis* to southern Australia, threatening commercial stocks of shellfish species such as oysters and scallops.

Environmentally sound methods of ballast water management under investigation worldwide include several types of treatment technologies. The degree to which any technology can be used to treat ballast water

depends on several factors including the biological treatment efficacy (i.e., organism's susceptibility to specific treatment); environmental acceptability (i.e., little or no impact on the receiving environment); shipboard practicality (i.e., can it be applied aboard vessels); cost effectiveness; and safety. Issues surrounding ballast water treatment technology include the availability of approved national and international ballast water treatment standards and processes for certifying the treatment technologies for which rapid progress has been made in the past year.

The U.S. Environmental Protection Agency (EPA), NSF International, Battelle, and United States Coast Guard are jointly developing a protocol for verifying the technical performance of commercially available technologies designed to treat ship ballast water for potentially invasive species. The protocol is being developed under the EPA's Environmental Technology Verification (ETV) Program, which will also conduct verification tests of technologies according to the protocol.

The protocol was developed with extensive input from a ballast water stakeholder group and a technical panel that included representatives from the developing ballast water treatment industry, federal and state agencies, non-governmental organizations, and scientists involved in the ballast water issue. A pilot test of the verification protocol is planned to occur at the Naval Research Laboratory's Key West, Florida facility in 2005.

For further information, contact Dr. Carlton Hunt at (781) 952-5374, huntc@battelle.org.



Close-up of Zebra mussel

Prioritizing Environmental Risks for the *United States Army*

Prior to the allocation of remediation funding, the Defense Environmental Restoration Program (DERP) management guidance requires the scoring and ranking of all sites eligible for cleanup to determine the degree of potential environmental risk in relation to other eligible cleanup sites. To qualitatively address the potential risk posed by each site, a process combining the evaluation of relative contamination level, contaminant migration potential, and possible contamination receptors is implemented. In this manner, all U.S. Army sites may be compared on a uniform scale to facilitate “worst-first” allocation of funds for remedial or corrective actions. This process is known as a Relative Risk Site Evaluation (RRSE).

Battelle was tasked to perform an RRSE for sites located at Sunflower Army Ammunition Plant (SFAAP) in DeSoto, Kansas. SFAAP is currently in layaway status but manufactured nitroguanidine, nitrocellulose, and nitroglycerin for decades. The purpose of this study was to provide sufficient data to rank 20 ‘not evaluated’ sites at SFAAP in accordance with the guidelines set forth by the Office of Deputy Under Secretary of Defense (Environmental Security) in the 1997 Revised Draft Relative Risk Site Evaluation Primer.

Battelle personnel collected numerous surface soil, sediment, and ground-water samples throughout the 20 sites at SFAAP in accordance with a sampling and analysis plan. Most of the samples were analyzed for total metals, volatile organic compounds, and semi-volatile organic compounds, with additional samples requiring analysis for polychlorinated biphenyls, nitrates/nitrites, nitroglycerine, and nitroguanidine.

RRSE scoring guidance requires site evaluation of six environmental media of concern, including: ground water (human endpoint), surface water (human endpoint), sediment (human endpoint), surface soil (human endpoint), surface water (ecological endpoint), and sediment (ecological endpoint). Each of these media, when appropriate, was evaluated by assessing the level of relative contamination, contaminant migration potential, and possible receptors of the contamination.

Based on the analytical data, exposure pathways, and receptors, 3 of the 20 sites at SFAAP had a high relative risk and 9 of the sites were recommended for No Further Action.

For further information, contact Mr. John Bauer at (410) 306-8621, bauerj@battelle.org.

Coastal Security Program Inaugurated

In August 2004, a new coastal security program designed to develop advanced sensors capable of providing early warning of biological, chemical, or nuclear material releases in marine and coastal environments was instituted at the Pacific Northwest National Laboratory's (PNNL) Marine Research Operations in Sequim, Washington. PNNL is operated for the U.S. Department of Energy by Battelle.

One part of the program will be centered on developing a new generation of sensors and technologies to detect the presence of weapons of mass destruction or 'signatures' as they are sometimes identified. For example, researchers will evaluate the use of living marine systems (such as clams and mussels) as biosensors to concentrate and detect the presence of biological, chemical, or nuclear materials in coastal waterways, beaches, and estuaries.

Another will investigate the possibility of developing novel ultra-small nanomaterials to serve as surrogate collectors and sensors. These 'smart' sensors are designed to selectively capture and pre-concentrate signatures in the marine environment. "The vision is to establish a network of

sensors and biosensors that can be easily and inexpensively deployed across wide regions on or near the shore. This network would serve as an early warning system for coastal security," said Project Manager, Ms. Karen Steinmaus.

Through the program, Battelle researchers also will enhance imaging technologies so intelligence and national and homeland security agencies can better identify and describe potential terrorism targets. Additionally, they will develop and improve ocean transport computer models that can analyze a signature's origin and predict its future path.

Already a recognized leader in marine sciences research, PNNL established a Coastal Security Institute in 2002 to provide a full set of measurement, assessment, and interpretive tools and capabilities to federal, state, and local governments and those in the commercial sector charged with the security of near-shore regions.

Marine Sciences Division Director, Dr. Richard Ecker, sees both environmental and security research benefiting from the new emphasis. "While PNNL scientists and engineers will apply what they've learned through environmental assessment research to our coastal security efforts, our new programs in coastal security will provide reciprocal value for our environmental science counterparts who can leverage them for other government agencies," Ecker said.

For more information, contact Ms. Karen Steinmaus at (360) 681-3646, karen.steinmaus@pnl.gov, or Mr. Don Bradley, Coastal Security Institute, at (360) 681-4585, don.bradley@pnl.gov.

Early-warning sensor systems (above) are being developed that can collect samples from the top microlayer of water where contaminants can concentrate, enabling more sensitive, accurate and early identification of contaminants of concern.



Water Security Assessments for the National Homeland Security Research Center

With Homeland Security a major concern since September 11, 2001, one of the most vulnerable areas identified by the National Homeland Security Research Center (NHSRC) is ensuring the safety of our water. The safety of our household water resources has become a major priority for the NHSRC, a division of the United States Environmental Protection Agency (U.S. EPA).

Realizing the importance of safeguarding our water, Battelle has devoted significant resources toward research to help detect, prevent, protect against, respond to, and recover from contamination in the event of chemical and biological attacks on our water infrastructure. Battelle has had extensive experience in successfully completing projects in these areas for clients including the U.S. EPA, U.S. Coast Guard, Department of Defense, and Department of Homeland Security.

Battelle currently is involved in at least four such water security projects for the NHSRC: (1) inactivation, disinfection, and removal of human pathogens from water; (2) determining the possibility of intentional contamination; (3) determining the effect of regular household activities (boiling or showering) as a vehicle for dispersing harmful agents; and (4) conducting chemical and biological decontamination of water distribution systems. The primary objectives of these studies are to determine ways to

The water supplied to U.S. communities is potentially vulnerable to terrorist attacks by insertion of biological agents, chemical agents, or toxins. The possibility of attack is of considerable concern...these agents could be a threat if they were inserted at critical points in the system; theoretically, they could cause a large number of casualties.

—The President's Critical Infrastructure Assurance Office



protect and decontaminate the nation's water supplies from chemical and biological attack and to prevent human exposure wherever possible.

Studies focus on inactivation and disinfection by a number of physical and chemical processes, and understanding fate, transport, and risk associated with water-borne chemicals and pathogens. Exposure to aerosolized contaminants by showering or boiling can cause exposure by inhalation and absorption through the skin, and therefore, studies are undertaken to determine the possibility of dispersing contaminants. A bench-scale study is being conducted to provide information to set new standards for materials and decontamination methodologies for safer water distribution systems.

Results of the ongoing projects will be used by the NHSRC to develop an early-warning system

for high-impact contamination events in source water or distribution systems in time to allow an effective local response. The information will be used to develop preventive measures, to treat water if it becomes infected, and to help dispose of contaminated water after treatment.

For more information on Battelle's NHSRC water assessments, contact Dr. Sandip Chattopadhyay at (614) 424-3661, chattopadhyays@battelle.org.

Testing Radiation Detectors to Provide a *More Secure Environment*

A marathon of testing has begun at the Battelle-managed Pacific Northwest National Laboratory (PNNL) to ensure that personal radiation equipment purchased with Department of Homeland Security (DHS) funds meets new operational standards and helps provide a secure environment.

“These pocket-sized personal radiation detectors and hand-held radiation survey meters play a critical role in effective threat detection for law enforcement, fire patrols, hazardous material experts, and other emergency first-responders,” said PNNL physicist, Dr. Joe McDonald.

PNNL was chosen by DHS in 2003 to develop standards and complete a very thorough evaluation of the equipment. Dr. McDonald chaired a 17-member committee tasked with developing the standards for personal radiation detection. “The committee was challenged to develop the standards in record time – six months – and the pace remains brisk during the testing phase,” said Dr. McDonald. Under normal conditions, it wouldn’t be unusual to manage this type of testing over a period of two years.

More than 100 instruments, representing approximately 30 different equipment models, will have their electrical systems, mechanical operations, environmental susceptibilities, and radiological sensitivities evaluated.

Upon completion, a *Consumer Report*-style publication will be developed for DHS, enabling first-responder personnel to be matched with equipment on a case-by-case basis. First-responders will be able to select equipment based on actual instrument performances.

Team leader, Mr. Phil Smith, explained that the ‘one size fits all’ approach doesn’t work for first-responders. “The U.S. Coast Guard has a keen interest in how equipment holds up to water and humidity; urban-area security

personnel look closely at features such as size, portability, and detector reaction time,” said Mr. Smith.

Realistic conditions are simulated in the testing process. Temperatures will include highs, lows, and rapid changes. Detection equipment will be exposed to vibrations, humidity, and electromagnetic fields. The equipment will also be evaluated for its ability to withstand anticipated wear and tear.

Calibration team members believe that the American National Standards Institute criteria for performance will ultimately raise the quality of detection devices available. Because manufacturers want their equipment to score well and gain acceptance from government buyers, they have been very interested in working to produce the best possible product.

“A win for us is not just completing the testing on schedule, but providing information that makes it possible to get reliable equipment in the field as quickly as possible. On-time

completion will enable DHS to allocate immediate funding for agencies that have urgent business in the line of first response,” said Dr. McDonald.

For more information contact Mr. Kelvin Soldat at (509) 375-6810, kelvin.soldat@pnl.gov.



PNNL Technician Phil Smith prepares pocket-sized radiation detection pagers for reliability testing. Test results of hand-held and pocket-sized equipment are made available to DHS, to aide in the selection of equipment for first-responders.



Landing on its Feet: Local Hospital Reduces *Patient Falls*

After accumulating a higher-than-average number of patient falls in recent years, Our Lady of Lourdes Hospital in Pasco, Washington, was able to land on its feet last year with the help of Battelle engineers at Pacific Northwest National Laboratory (PNNL).

Using a risk assessment analysis facilitated by PNNL researchers, the hospital was able to cut patient falls by an astonishing 42 percent over just 15 months.

“There are so few engineers in the medical field that hospital risk management staff asked for our help in meeting new patient safety standards set by the hospital accrediting organization, specifically on slips and falls analysis,” said PNNL’s Garill Coles, who led the risk assessment team.

Coles mentored Lourdes staff in the use of a common engineering tool in risk assessment to examine the policy, procedures, and practices related to patient fall risk. He asked hospital management to consider how they could fail

and what the consequences of that failure would be.

They then identified the safeguards in the current process, such as double checking patient charts to make sure patients at risk of falling were properly identified when they were first admitted to the hospital. An algorithm was used to score the vulnerability in the system, and categorized those failure modes as high, medium or low risk.

In response to the study, Lourdes now implements an updated patient assessment of fall risk upon the patient’s arrival at the hospital, holds staff refresher courses, uses bed alarm systems, color-codes charts of patients at risk of falling, and improved the Patient Fall Risk Care Plan process to allow hospital staff to provide the proper level of patient care.

For more information, contact Mr. Garill Coles at (509) 372-6246, garill.coles@pnl.gov, or Mr. Kelvin Soldat at (509) 375-6810, kelvin.soldat@pnl.gov.

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