Superfund
Scoop
fall 2010 • Issue #10
THE NEWSLETTER OF THE UNC SUPERFUND RESEARCH PROGRAM

Visit us on the web: **www.uncsrp.org**

inside the scoop

RESEARCH HIGHLIGHTS
UNC SRP Scientists Uncover Soil Microbes that Consume Contaminants and Speed Up Degradation 2

RESEARCHER PROFILE
Cutting-edge Environmental Toxicity Research Lab Improves Understanding of Chemicals that Affect Health 4

RESEARCH TRANSLATION
RTC Project Tracking NC Private Well Contamination Celebrates Successes and Looks Ahead 5

Learn How to Turn Your Research into a Business with UNC OTD 6

The UNC SRP brings together a diverse group of more than 70 biomedical researchers, engineers, chemists, statisticians, experts in conventional and bioremediation, environmental modelers and students. Together, we are achieving the program's goal to advance society's understanding of the human health and environmental risks associated with hazardous waste and to develop new environmental strategies and technologies for the cleanup of Superfund sites, thereby minimizing human and environmental risk.

UNC SRP Scientists Uncover Soil Microbes that Consume Contaminants and Speed Up Degradation

IN SRP INVESTIGATOR MIKE AITKEN'S LAB, A LONG-TERM project to speed up the biodegradation of a common type of hazardous industrial chemical is shedding light on what's going on underground at many of the nation's contaminated sites. PhD students Stephen Richardson and Maiysha Jones have identified microbes that are responsible for breaking down six different polycyclic aromatic hydrocarbons (PAHs), a common type of contaminant at Superfund sites, and just how much of the chemical they can consume.

Richardson used laboratory columns filled with contaminated soil to measure the extent of bioremediation (the quantity of the PAHs that can be consumed and broken down by the microbes) that is achievable by improving the microbial growing environment in the soil. Over the last 2.5 years, he has treated samples of contaminated soil taken directly from a former manufactured gas plant by pumping in extra oxygen, nitrogen and phosphorus that the microbes need to break down the PAHs.

Richardson demonstrated that this long-term approach led to considerably more biodegradation than the most popular current laboratory test would have predicted. This experiment ran for over two years rather than the short-duration lab test. Because of the experiment's duration, he was able to show that although the degradation slows down considerably, it does not stop, and so little by little more contaminants are eaten up.

Maiysha Jones and Stephen Richardson

At the same time, Jones was working to identify which specific microbes were responsible for degrading each of six different 2, 3 and 4-ring PAHs (anthracene, benz[a]anthracene, fluoranthene, naphthalene, phenanthrene, and pyrene).

She applied a method called stable isotope probing which uses PAHs labeled with heavier-than-normal carbon molecules (carbon-13). When microbes living in the contaminated soil consume these PAHs, their DNA takes in these heavier carbons. Then, when the DNA

"We're on the road to being able to use advanced molecular techniques to more completely understand bioremediation systems, particularly to develop predictive capabilities, in the not-too-distant future."

is extracted from the soil bacteria, it can be separated based on density and which bacteria consumed the labeled PAHs can be identified.

Jones' stable isotope probing work was made possible by the unique capabilities of the UNC SRP Chemistry and Analytical Core, which was able to synthesize the six different carbon-13 labeled PAHs necessary for the tests.

She did her stable isotope detective work on the microbes that were originally present in the soil, but she and Richardson also collected DNA from the microbes in the columns throughout the long experiment. Now that they know which microbes consume the most of each chemical, they can run high-throughput sequencing tests to see how the populations of each of the different organisms fared over time throughout the treatment of the soil.

Both Richardson and Jones won Impact Awards from the UNC Graduate School for their research, and Richardson has also recently won a separate award for his dissertation from the UNC School of Public Health.

Thanks to this work, project managers who clean up sites contaminated with PAHs will have better information about which microbes in their soil will break down specific PAHs and can better predict how much of the chemicals those microbes will be able to consume, given the best growing conditions.

On the recent accomplishments of his team, Dr. Aitken says "We're on the road to being able to use advanced molecular techniques to more completely understand bioremediation systems, particularly to develop predictive capabilities, in the not-too-distant future."

Next, Dr. Aitken plans to direct his lab towards studying the toxicity of these contaminated soils before and after biodegradation occurs to determine whether speeding up biodegradation in this way can reduce the risk to human health. ●

Dr. Mike Aitken

Cutting-edge Environmental Toxicity Research Lab Improves Understanding of Chemicals that Affect Health

Dr. Ivan Rusyn

DR. IVAN RUSYN LEADS A CUTTING-EDGE ENVIRONMENTAL toxicity research lab with the UNC Superfund Research Program, which improves understanding of the ways that exposures to certain chemicals lead to adverse health effects, and was the first to report on the genetic regulation of gene expression in the liver. Rusyn has served on a number of committees of the National Academies of Science and the EPA Science Advisory Board evaluating the health risks associated with trichloroethylene, tetrachloroethylene, trichloroacetic acid and formaldehyde. However, the series of steps that he took to get to this position in his career began in a much different place and have since taken him around the world.

After he was first trained as a physician, receiving his M.D. from Ukrainian State Medical University in Kiev in 1994, Rusyn had completed a year of postdoctoral work at University of Düsseldorf, Germany and his PhD at UNC Chapel Hill. After further postdoctoral work at UNC and MIT, he began working for UNC in 2002 as an Assistant Professor in the UNC School of Public Health's Department of Environmental Sciences and Engineering where he continues today as a full professor.

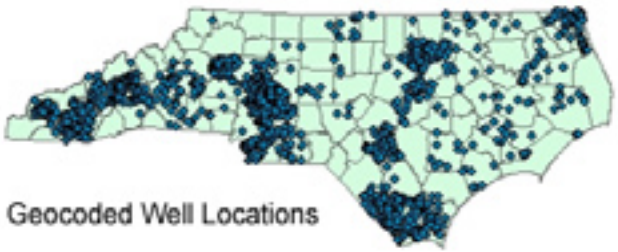
Rusyn's research interests include: environmental agent-related organ injury and carcinogenesis using molecular, biochemical, genetic and genomics approaches. Following those interests, he currently leads a project in the Superfund Research Program entitled "Genomic and Genetic Analysis of Liver and Kidney Toxicity to Trichloroethylene," which Rusyn explains is now focused on "integrating traditional toxicology research approaches with the knowledge of genetic variation using trichloroethylene as a model environmental contaminant, and dissecting complex mechanisms of action of an environmental agent by constructing kinetic models of individual-to-population risk of toxicity." This research is of relevance to risk assessment as it "provides important quantitative information on the metabolism of trichloroethylene to both liver- and kidney-toxic intermediates, as well as characterizes the extent of the inter-individual variability in such metabolism using various inbred mouse strains," Rusyn explains.

RTC Launches Private Well Water Website and Builds Capacity with State Agencies

OVER THE LAST YEAR THE UNC SRP RESEARCH TRANSLATION Core has partnered with Medical Evaluation and Risk Assessment (MERA) program of the North Carolina Department of Health and Human Services (NCDHHS) to develop the capacity of NCDHHS to identify North Carolina populations at greatest potential risk from well water contamination.

In this past year, the RTC has made connections between NC DHHS, NC DENR, and UNC researchers including, Drs. Rebecca Fry and Marc Serre, and has established an interagency team which has guided the creation of contaminant maps for several key organic and inorganic contaminants.

In the coming year the RTC will focus on providing an online hub for the agencies involved to share information with NC well owners who have recently had their well tested. Upon receipt of their test results they will be directed to this website for more information. This resource will increase access to information that can help well owners understand potential risks, explore their options for water purification systems if necessary, and ultimately, reduce their exposure to the identified contaminants.



Learn How to Turn Your Research into a Business with UNC OTD

Carolina Innovations Seminar

Thursday, October 7, 2010, 5:30–6:30pm

014 Sitterson Hall, UNC-Chapel Hill

A Guide to the Promises and Perils of Entrepreneurial Passion

Speaker: John Bradberry, CEO, Ready Founder Services

JOHN BRADBERRY HAS WORKED for two decades as a business consultant, entrepreneur, and investor, and is the author of the upcoming book, *Secrets of Startup Success: How to Turn Your Entrepreneurial Passion into a Thriving Business* (March, 2011, American Management Association). In researching the book, he discovered that the "secrets" of entrepreneurial success are not so secret, and not very hard to grasp. But founding teams often overlook vital startup fundamentals, severely undercutting their odds of success.

John Bradberry

Superfund Research Program

SUPERFUND SCOOP

This newsletter is published by the UNC-Chapel Hill Superfund Research Program, with funding from grant number P42-ES005948 from the National Institute of Environmental Health Sciences, NIH.

JAMES A. SWENBERG
Program Director
919.966.6139
james_swenberg@unc.edu

FREDERIC PFAENDER
Research Translation Leader
919.966.3842
fred_pfaender@unc.edu

KATHLEEN GRAY
Research Translation Co-Leader
919.966.9799
kathleen_gray@unc.edu

LAURA ERTEL, *Writer*
REGINA MCCOY, *Design/Layout*: *CHAI Core, funded by the Nutrition Obesity Research Center and the Nutrient Assessment Facility Core*

UNC GILLINGS SCHOOL OF GLOBAL PUBLIC HEALTH