



Newsletter written and compiled by
Nicole Damon

Inside this issue:

<i>Project Spotlight</i>	1
<i>Postdoc Interview</i>	3
<i>Grad Student Interview</i>	5
<i>Events List</i>	6

Uptake of Pharmaceutical and Steroidal Compounds by Quagga Mussels in Lake Mead

Lake Mead is the primary water source for the Las Vegas metropolitan area and a habitat for diverse wildlife, including endangered species such as the razorback sucker. Because Lake Mead continuously receives treated wastewater from the Las Vegas Wash, it's important to understand the prevalence of untreated emerging contaminants—such as pharmaceutical and personal care products and steroidal hormones—in the lake and their effects on wildlife.

This project will evaluate the uptake rates of select contaminants from pharmaceutical and personal care products in quagga mussels (*Dreissena bugensis*) to understand the effects of these contaminants on aquatic species in Lake Mead. Quagga mussels are an invasive species that have been spreading rapidly in the lake since they were first detected in 2007. The researchers will study a group of trace organic chemicals that includes antibiotics (azithromycin, ciprofloxacin, and sulfamethoxazole),

RFPs

If you have questions about submitting a NWRRRI proposal, e-mail Amy Russell (Amy.Russell@dri.edu).

For current RFP information, visit the NWRRRI website (www.dri.edu/nwrrri).



The Las Vegas Wash receives reclaimed water, shallow ground water, urban runoff, and storm water that then drain into Lake Mead.

(Project Spotlight continued)

antidepressants (fluoxetine, temazepam, and venlafaxine), an anticonvulsant (carbamazepine), and a steroidal hormone (estrone). “These trace organic chemicals represent highly prescribed and widely used pharmaceutical compounds and personal care products that are present in municipal wastewater, and many of them have been detected in fresh water and drinking water,” explains Dr. Xuelian Bai, one of the principal investigators of the project that also includes Dr. Kumud Acharya. “The target antidepressants have been reported at high accumulation rates in fish tissues, and carbamazepine and estrone have been found to cause adverse effects in aquatic species, even at trace levels.”

Concerns regarding pharmaceutical and steroidal compounds are increasing because of their ubiquitous presence in aquatic environments and the ecological risks they present for aquatic ecosystems such as Lake Mead. This project will provide insight into the exposure pathways of these chemicals and their effects on nontarget species to help develop ecological risk assessments. The researchers will evaluate the ambient concentrations and quagga mussel uptake rates of trace organics. Understanding the bioaccumulation of trace organic chemicals in quagga mussels will



Assessing the bioaccumulation of trace organics in quagga mussels will allow researchers to understand contaminant exposure routes in Lake Mead.

clarify their exposure routes in the Lake Mead ecosystem, either directly from water or by feeding on algae. “In an aquatic environment, mussels release pseudofeces that can be consumed by fish or other organisms in the benthic zone,” Bai says. “During this process, trace organic chemicals can be transferred via the food web and accumulate in higher-trophic-level organisms.”

The researchers will collect water and quagga mussels from Las Vegas Bay in Lake Mead, where treated wastewater enters the lake and is likely affected by the discharge, and the Lake Mead Marina, which is closer to Hoover dam and perhaps less affected by wastewater

discharge because of dilution and natural attenuation. They will then use liquid chromatography-tandem mass spectrometry to analyze the water and mussel samples for the target contaminants and assess the doses that the mussels are exposed to in Lake Mead. A series of bench-scale experiments will also be conducted to evaluate the bioaccumulation of the contaminants in the mussels to understand if they uptake contaminants directly from the water or by consuming algae. “To date, most research has been focused on the uptake of trace organic chemicals by aquatic organisms at higher trophic levels, such as fish,” Bai explains. “Currently, there is little information about the uptake

“This research will provide vital information about the bioaccumulation of trace organic chemicals in the food web of the Lake Mead ecosystem and the effects of trace organic chemicals on nontarget species.” – Xuelian Bai

(Project Spotlight continued)

of trace organics by lower-trophic-level organisms, such as phytoplankton and zooplankton, which are food for higher-trophic level organisms. The role that quagga mussels play in the fate and persistence of trace organic chemicals in the aquatic environment is also still unclear. This research will provide vital information about the bioaccumulation of trace organic chemicals in the food web of the

Lake Mead ecosystem and the effects of trace organic chemicals on nontarget species.”

Lake Mead is not only the primary water supply reservoir for the Las Vegas metropolitan area, but it is also a receiving water body for four major wastewater treatment plants. Because southern Nevada is an arid/semiarid region, water quality is a significant issue. Understanding the presence and effects of emerging contaminants

in this water source is a critical issue for both regulators and the public. Bai adds, “This project will also provide useful information for ecological risk assessments and recommendations for improving wastewater treatment technology, such as advanced treatments to reduce or eliminate trace organic chemicals in treated wastewater to protect aquatic ecosystems.” ■

Postdoc Interview: Hai Pham

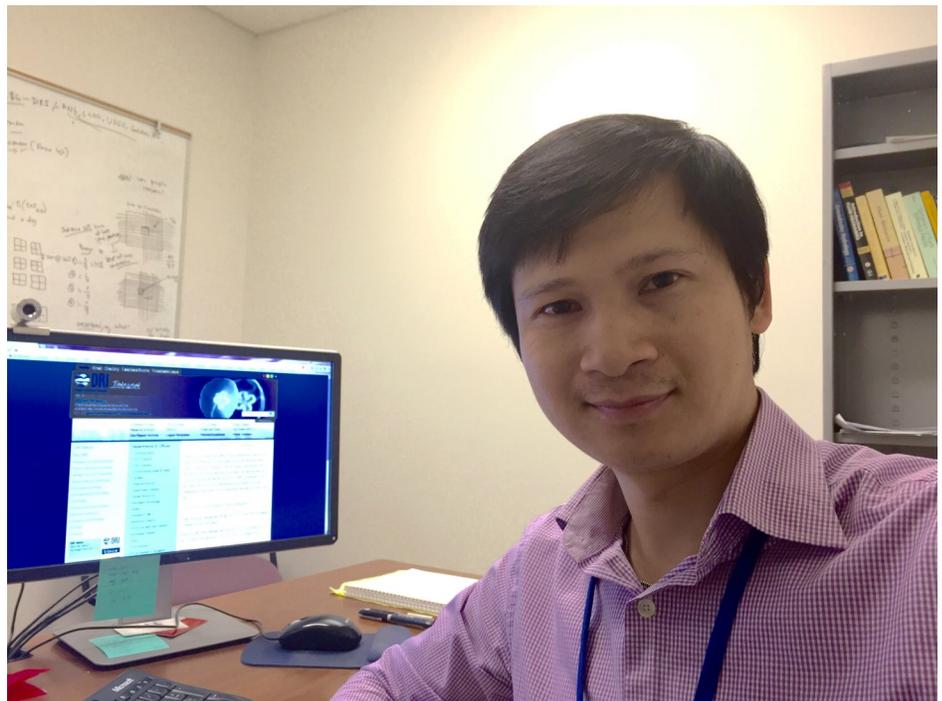
We asked Postdoctoral Fellow Dr. Hai Pham about his current research and his continuing research plans. Here’s what he had to say:

1) What do you find most interesting about water resources research, particularly working in an arid/semiarid environment such as Nevada?

In arid/semiarid regions such as Nevada—where rainfall is scarce and surface water is not available and/or of poor quality—groundwater plays an important role in socioeconomic development. Nevada is facing major groundwater issues, such as groundwater availability, natural and artificial groundwater recharge, and underground storage of hazardous wastes. My research goal is to find new ways to model the Nevada groundwater systems to protect, restore, and promote sustainable groundwater use.

2) What kinds of research are you currently working on and what have you learned so far from this research?

One of my primary focuses is to study fluid flow and contaminant characteristics in fractured rock.



This is a crucial part of long-term storage of radioactive waste in subsurface repositories. In fractured rock, fracture networks are typically the main pathways for flow and contaminant transport. Discrete fracture network (DFN) modeling is one of the most powerful numerical modeling approaches, but 3-D DFN model simulations are challenging because

fractured rocks are difficult to characterize and these simulations create a high computational burden. I am working to construct 3-D DFN models and run them in a high-performance system. The ultimate goal of this study is to investigate transport characteristics in the 3-D DFN under various uncertainties.

(Continued on next page)

(Postdoc Interview continued)

3) What do you hope to learn more about from the research you are doing?

I would like to gain a better understanding of fluid flow and contaminant characteristics using 3-D DFN models. This is different from previous studies that use 2-D DFN models or different modeling approaches (e.g., the equivalent continuum model or dual-continuum model). The flow and transport characteristics of 3-D stochastic DFN models could also help develop upscaling methods for fractured systems and incorporate upscaling methods into studies of flow and contaminant characteristics.

4) Do you have a preference for lab work or fieldwork, and if so, why?

I prefer fieldwork because I like to be outside. Unfortunately, the majority of my research is laboratory based. I spend most of my time developing and configuring numerical models, writing computer programs and scripts, conceptualizing and developing research proposals, and preparing technical reports and peer-reviewed journal articles. If possible, I would prefer a good balance of fieldwork and lab work.

5) What are some of your other research interests? Do you have any goals for incorporating those interests into your work as you continue in your career?

A lack of hydrogeological data leads to uncertainty in numerical modeling, and many conceptualizations have been proposed to represent uncertainty in model components. Once I've constructed the 3-D DFN models, I will use them to study how conceptual and parametric uncertainties influence transport behavior in 3-D DFNs. I will conduct spatial and temporal analyses of the contaminant plumes to compute the influence of uncertainty on transport behavior. The flow and transport characteristics of 3-D stochastic DFNs under uncertainty will help lay the groundwork for model development and analysis of field-scale fractured rock systems.

6) If you could go on vacation anywhere in the world, where would you want to go, why would you want to go there, and what would you want to do there?

If I could take a vacation anywhere, I would want to take a trip that would allow me to visit

most of the countries in Europe. I'd really enjoy discovering famous architectural and historical areas, and sampling the delicious cuisine and beer. I'd also like to watch a Chelsea game, which is my favorite soccer team.

7) If you were shipwrecked on a deserted island, but all of your human needs (food, water, etc.) were taken care of, what two items would you want to have with you?

A laptop connected to the internet and a solar-powered generator.

8) If you had six months with no obligations or financial constraints, what would you do with the time?

I would love to spend time playing with my two sons and travel around the world with my family.

9) Cake or Pie?

Neither of them; I don't like sweets. ■

“Nevada is facing major groundwater issues, such as groundwater availability, natural and artificial groundwater recharge, and underground storage of hazardous wastes. My research goal is to find new ways to model the Nevada groundwater systems to protect, restore, and promote sustainable groundwater use.” – Hai Pham

Grad Student Interview: Crystal DuBose

We asked graduate student Crystal DuBose about her current studies and her plans for the future. Here's what she had to say:

1) What field are you currently studying and what sparked your interest in that field?

I am currently studying hydrogeology for my master's degree. The extreme nature of floods, hurricanes, and droughts and the processes that generate such environmental hazards sparked my curiosity in hydrology. I chose hydrogeology for my master's because I like that it provides a more mathematical approach for solving water related issues.

2) What research project are you currently working on and what research are you doing?

The research project I'm working on is titled "Estimating Future Flood Frequency for Regions in the Southwest." The goal of this project is to try to predict how often it will flood in the future (i.e., for the time period 2041-2070) because of climate change. To accomplish this task, we are developing a simple yet effective statistical model that correlates extreme precipitation events with flood frequency events. Currently,

we are looking at the Virgin River watershed, but we hope to apply this model to other Southwestern locations—such as the Colorado River Basin and southern Nevada—where flash flooding is a recurring issue.

3) What have you learned from working on this project?

I have learned more about the statistical methods used when developing a design storm and performing a regional frequency analysis, such as distribution type, exceedance probability, return periods, and hypothesis testing. Furthermore, analyzing hydrological time series in a high temporal resolution required me to learn programming languages such as C++ and Python.

4) What have you enjoyed most about working on this project?

Working as a team to solve future flooding issues is what



makes this project most enjoyable. It's gratifying to know our research will potentially be beneficial to the hydrologic community and possibly affect the decisions agencies and water managers make to properly prepare for future flooding events.

5) What are your goals for the next step in your career?

I hope that eventually I will get a job with the Southern Nevada Water Authority, National Water Resources Association, or USGS. ■

"Working as a team to solve future flooding issues is what makes this project most enjoyable. It's gratifying to know our research will potentially be beneficial to the hydrologic community and possibly affect the decisions agencies and water managers make to properly prepare for future flooding events." – Crystal DuBose

Upcoming Events

2016 GSA Annual Meeting
September 25-28
Denver, CO
community.geosociety.org/gsa2016/home

Fall 2016 History of Water in Nevada Event
October 24-25
Reno, NV
www.nvwra.org/2016-water-history-event

2016 Borehole Geophysical Logging
Workshop
October 26
Reno, NV
www.nvwra.org/2016borehole-geophysical-logging-workshop

Lithium Workshop
October 27
Reno, NV
www.nvwra.org/2016lithium-workshop

2016 Nevada Well Drilling Regulations &
Forms Class and Water Well Drilling Exam
Tutorial
October 27
Reno, NV
www.nvwra.org/2016wellregs

ASA, CSSA, and SSSA: Resilience Emerging
from Scarcity and Abundance
November 6-9
Phoenix, AZ
www.acsmeetings.org/

Desert Terminus Lakes Symposium
November 9-10
Reno, NV
greatbasinresearch.com/walker/symposium/

2016 AWRA Annual Conference
November 13-17
Orlando, FL
www.awra.org/meetings/Orlando2016/

Groundwater Week
December 6-8
Las Vegas, NV
groundwaterweek.com/



AGU Fall Meeting 2016
December 12-16
San Francisco, CA
fallmeeting.agu.org/2016/

AGU Chapman Conference: Extreme Climate Event
Impacts on Aquatic Biogeochemical Cycles and
Fluxes
January 22-27, 2017
San Juan, Puerto Rico
chapman.agu.org/extremeclimate/

Water Rights in Nevada Class
February 13, 2017
Reno, NV
www.nvwra.org/2017-water-rights-seminar

2017 Mine Water Management Symposium
February 13-14, 2017
Reno, NV
www.nvwra.org/2017-symposium

Advanced Water Rights in Nevada Class
February 14, 2017
Reno, NV
www.nvwra.org/2017-adv-water-rights-seminar

2017 NWRA Annual Conference
February 14-16, 2017
Reno, NV
www.nvwra.org/2017-annual-conference-program

NWRRI - Desert Research Institute

Success and the dedication to quality research have established the Division of Hydrologic Sciences (DHS) as the Nevada Water Resources Research Institute (NWRRI) under the Water Resources Research Act of 1984 (as amended). As the NWRRI, the continuing goals of DHS are to develop the water sciences knowledge and expertise that support Nevada's water needs, encourage our nation to manage water more responsibly, and train students to become productive professionals.

Desert Research Institute, the nonprofit research campus of the Nevada System of Higher Education, strives to be the world leader in environmental sciences through the application of knowledge and technologies to improve people's lives throughout Nevada and the world.

The work conducted through the NWRRI program is supported by the U.S. Geological Survey under Grant/Cooperative Agreement No. G16.AP00069.



www.dri.edu/nwrri

For more information about the NWRRI, contact:

Amy Russell, Business Manager
702-862-5471
Amy.Russell@dri.edu

Jim Thomas, Director
775-673-7305
Jim.Thomas@dri.edu

Banner photo: Aspens during autumn in Lamoille Canyon, Nevada, by Famartin - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=28885229>

Page 1: Lower Las Vegas Wash near its drainage into Lake Mead by Stan Shebs, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=6310546>

Page 2: *Dreissena bugensis*, courtesy of the U.S. Geological Survey, http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/quagga_gallery.aspx

Events listing: Petroglyphs in Valley of Fire State Park, Nevada, by Clément Bardot - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=25863791>