



Newsletter written and compiled by  
Nicole Damon

## *Evaluation of Antibiotic Resistance Genes (ARGs) in the Urban Wetland Ecosystem: Las Vegas Wash*

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Antibiotic resistance—the ability of bacteria to survive in the presence of antibiotics—is an increasing environmental and public health concern as more antibiotics enter urban waterways and treated wastewater is increasingly used to supplement limited water resources. Current wastewater treatment processes have difficulty removing antibiotics, which also encourages the growth of antibiotic resistance in urban watersheds, such as the Las Vegas Wash. “Contaminants that are

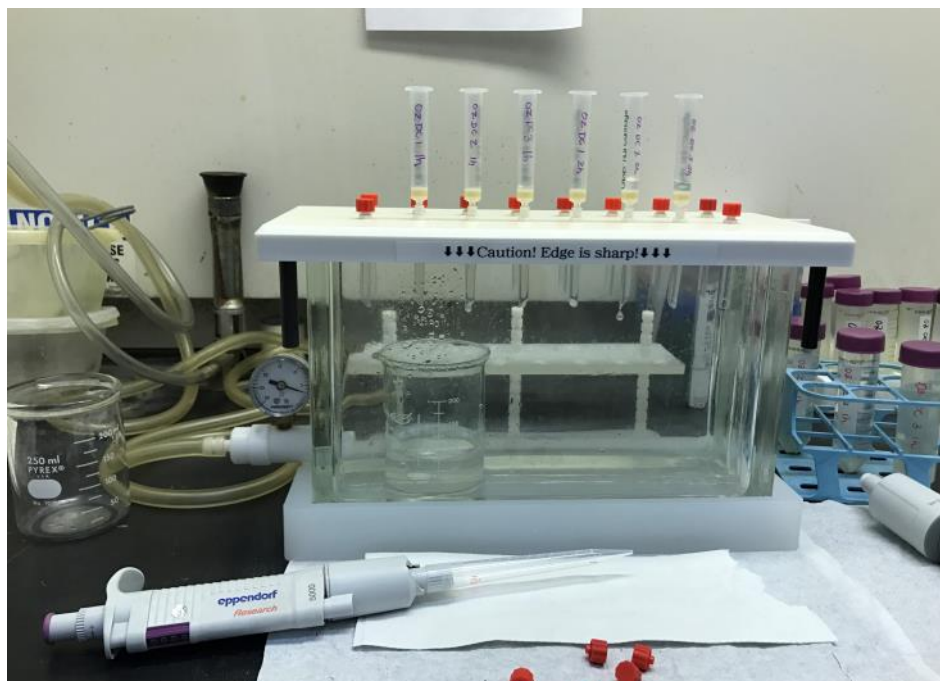
persistent in treated wastewaters that are discarded or reused may lead to health risks for humans,” explains Dr. Xuelian Bai, the principal investigator (PI) of this project that also includes co-PI Dr. Duane Moser and student researcher Rania Eddik-Zein. “The U.S. Centers for Disease Control and Prevention, the World Health Organization, and numerous other global and national agencies recognize antibiotic resistance as a critical challenge.”

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### RFPs

If you have questions about submitting a NWRRI proposal, email Amy Russell (Amy.Russell@dri.edu).

For current RFP information, visit the NWRRI website ([www.dri.edu/nwrri](http://www.dri.edu/nwrri)).



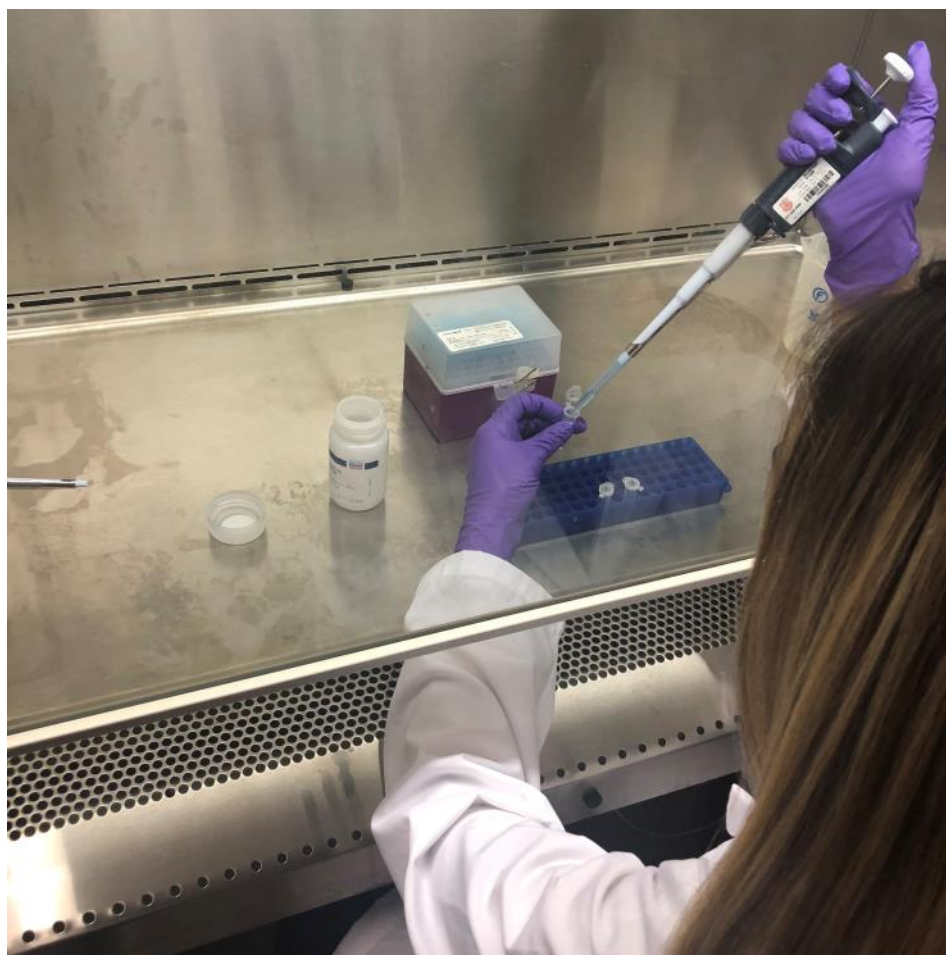
Solid-phase extraction to further clean up and concentrate antibiotics from surface water and wastewater samples.

*(Project Spotlight continued)*

The Las Vegas Wash is a unique watershed that is highly affected by anthropogenic activities and flooding during wet seasons. “A lot of research has been done to monitor chemical contaminants such as nutrients, heavy metals, and organic contaminants, as well as antibiotics in the Las Vegas Wash and Lake Mead,” Bai says. “However, there is still a lack of information on the presence of microbial contaminants and antibiotic resistance genes [ARGs] in the watershed.” Understanding the presence and abundance of ARGs in this watershed will provide insight into possible antibiotic resistance developing in the wash.

For this project, the researchers will evaluate the occurrence and prevalence of ARGs in the Las Vegas Wash. “Resistance to antibiotics is encoded in ARGs, which are segments of DNA that enable bacteria to fight antibiotics,” Bai explains. “The major concerns about antibiotic resistance are the tendency of bacteria to share ARGs through horizontal gene transfer and that efforts to kill resistant bacteria, such as UV or chlorine disinfection in wastewater treatment and drinking water facilities, may not remove ARGs.” The researchers anticipate that the data from this study will provide insight into the prevalence of ARGs in the wash and provide valuable information that can be used to determine water quality and potential human health concerns in southern Nevada.

First, the researchers will take field samples of water and sediment from the Las Vegas Wash to assess the



Rania Eddik-Zein preparing DNA samples from the Las Vegas Wash.

presence of ARGs in an urban wetland ecosystem. “Municipal wastewater appears to be a significant reservoir of ARGs,” Bai says. “Many studies have detected ARGs at all stages of the municipal wastewater treatment processes.” Urban water supplies are particularly susceptible to developing antibiotic resistance because of the concentrated quantities of antibiotics that are released when

treated municipal wastewater is discharged into the environment. “Microorganisms in wastewater discharge can transport ARGs to downstream surface waters used for recreation or sources of drinking water, which can lead to human exposure over local, or even global, scales,” Bai explains. “This is a concern in southern Nevada because five major wastewater treatment plants

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***“Because evaluating ARGs in surface water and sediment has not been fully studied locally or globally, this project will address local water issues in Nevada and provide useful antibiotic resistance data about urban watersheds that can be used worldwide.” – Xuelian Bai***

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*(Project Spotlight continued)*

discharge into the Las Vegas Wash. The Las Vegas Wash then discharges into Lake Mead, which is the primary drinking water supply for the Las Vegas Metropolitan Area.”

Lake Mead supplies water to millions of residents in the southwestern United States, so identifying potential antibiotic resistance is increasingly important, especially with the drastic population growth in the region. Effluent discharged from wastewater treatment plants, urban runoff, and floodwaters during wet seasons carry sediment, nutrients, and other contaminants to Lake Mead. This generates several water-quality concerns, particularly about the effects of contaminants on aquatic habitats. “The Las Vegas Wash provides the full continuum of major freshwater aquatic habitats, including

wetlands, flowing water, lake water, and sediment,” Bai explains.

“Wetlands, flowing water, and lake water are defined by aerobic conditions and exposure to photosphere influence. However, sediments almost always go anoxic very quickly below the surface, usually within millimeters in eutrophic systems. The fate of antibiotics and the microbial genes that mediate changes in anaerobes have been relatively understudied.”

The researchers anticipate that the field sampling and the lab studies conducted for this project—which include microcosm and microbial community experiments, and DNA analysis—will allow them to specifically identify southern Nevada water issues. “We will detect and quantify target ARGs in water

samples collected upstream and downstream along the Las Vegas Wash, as well as target ARGs in sediment samples collected from the Las Vegas Wash wetlands,” Bai says. “We will also determine the fate and spread of ARGs in the aquatic ecosystems, and assess the effects of elevated antibiotic concentrations on the ecosystem. Because evaluating ARGs in surface water and sediment has not been fully studied locally or globally, this project will address local water issues in Nevada and provide useful antibiotic resistance data about urban watersheds that can be used worldwide.” ■

## Upcoming Events

Rhizosphere 5  
July 7-11, 2019  
Saskatoon, Saskatchewan, Canada  
[www.rhizo5.org/home/index.html](http://www.rhizo5.org/home/index.html)

2019 Legislative Updates – Las Vegas  
July 18, 2019  
Las Vegas, NV  
[www.nvwra.org/2019legislativeupdates](http://www.nvwra.org/2019legislativeupdates)

2019 Legislative Updates – Reno  
July 24, 2019  
Reno, NV  
[www.nvwra.org/2019legislativeupdates](http://www.nvwra.org/2019legislativeupdates)

Chapman Conference: Understanding Carbon  
Climate Feedbacks  
August 26-29, 2019  
San Diego, CA  
[connect.agu.org/aguchapmanconference/upcoming-chapmans/carbon-climate](http://connect.agu.org/aguchapmanconference/upcoming-chapmans/carbon-climate)

23rd International Conference on Environmental  
Indicators  
September 9-12, 2019  
Haifa, Israel  
[icei-site.catom.site/Home](http://icei-site.catom.site/Home)

International Conference: Water Security - New  
Technologies, Strategies, Policies, and Institutions  
September 16-18, 2019  
Beijing, China  
[members.awra.org/DevMembers/Events\\_and\\_Networking/Events/INTERNATIONAL\\_CONFERENCE\\_Water\\_Security\\_New\\_Technologies\\_Strategies\\_Policies\\_and\\_Institutions.aspx](http://members.awra.org/DevMembers/Events_and_Networking/Events/INTERNATIONAL_CONFERENCE_Water_Security_New_Technologies_Strategies_Policies_and_Institutions.aspx)

Newmont Phoenix Mine Tour  
September 17, 2019  
Elko, NV  
[www.nvwra.org/2019-september-newmont-mine-tour](http://www.nvwra.org/2019-september-newmont-mine-tour)

GSA 2019  
September 22-25, 2019  
Phoenix, AZ  
[www.geosociety.org/GSA/Events/Annual\\_Meeting/GSA/Events/2019info.aspx](http://www.geosociety.org/GSA/Events/Annual_Meeting/GSA/Events/2019info.aspx)

2019 NGWA Conference on Fractured Rock and  
Groundwater  
September 23-24, 2019  
Burlington, VT  
[www.ngwa.org/detail/event/2019/09/23/default-calendar/5017sep19](http://www.ngwa.org/detail/event/2019/09/23/default-calendar/5017sep19)

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## *PI Spotlight: Dr. Xuelian Bai*

Dr. Xuelian Bai's research on chemical contaminants, such as pharmaceuticals and hormones, sparked her interest in emerging contaminants because she was concerned about chemicals entering the environment and affecting environmental and human health. "Numerous contaminants are released in human and animal waste that eventually enter the natural environment," Bai says. "However, there are still many unknowns about these contaminants, such as how long they will stay in the environment; how far they will transport into soil, water, and plants; and what kinds of health effects they have on wildlife and humans."

What Bai finds most interesting about researching emerging contaminants are the health issues that could be related to exposure. "We use a variety of synthetic chemicals on a daily basis that ultimately end up in the environment," Bai explains. "Therefore, there are always emerging contaminants and potential emerging health issues related to these contaminants. My goals are to use my research to improve public awareness of environmental science and contamination, and share my knowledge with science students."

Emerging contaminants are of particular concern because they aren't targeted by current wastewater treatment processes, and therefore



Dr. Xuelian Bai collecting sediment samples at the Las Vegas Wash to evaluate the presence of ARGs.

they may enter drinking water supplies, groundwater, soils, and food. "The most significant concern is that we do not know enough about the life cycle and risks associated with emerging contaminants," Bai says. "Studying these contaminants will help regulators evaluate risks, make recommendations for treatment, and take actions on policies and regulatory practices to mitigate the risks."

In addition to her interest in emerging contaminants, Bai is also researching the presence of microplastics in freshwater ecosystems. She is currently working on a project to identify and quantify microplastics in water and sediments. She and her student researcher Rania Eddik-Zein will then assess the potential bioaccumulation of microplastics in aquatic species using *Daphnia magna*, which are small

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## Student Interview: Raina Eddik-Zein

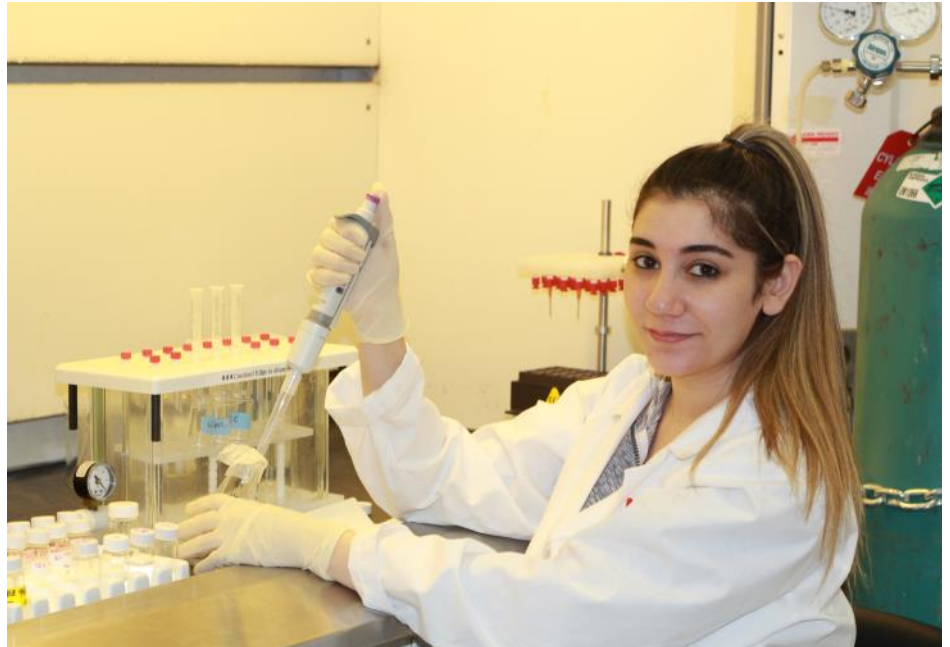
We asked undergraduate research assistant Raina Eddik-Zein about her current studies and plans for the future. Here's what she had to say:

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

I am pursuing a bachelor's degree with a double major in biology and psychology. I thought that I would pursue a master's degree in psychology because I've always been interested in understanding human perception. However, after completing my internship at Desert Research Institute (DRI) in the Division of Hydrologic Sciences, I found studying pharmaceuticals very interesting. It was interesting to learn about how pharmaceuticals are being released into our environment and how this could negatively affect water treatment processes, as well as aquatic ecosystems. I have also worked with invasive species, which has helped me better understand the importance of how rapidly our environment is being contaminated. Everything that I have learned will help me as I continue to study medicine and pharmaceuticals.



A micrograph of an adult *Daphnia magna* (photo: Dita Vizoso).



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

I'm currently working on the project titled "Evaluation of Antibiotic Resistance Genes (ARGs) in the Urban Wetland Ecosystem: Las Vegas Wash." I've been extracting DNA from water and soil samples collected from the Las Vegas Wash, and then I will be running the samples through the quantitative polymerase chain reaction (qPCR) instrument to see if there is any DNA from ARGs. If so, I will continue to research these ARGs to see how they have affected our ecosystem.

I am also working on a project to assess the uptake of microplastics in *Daphnia*, which are small aquatic crustaceans. I will be creating a favorable environment for the *Daphnia* to grow and reproduce at a healthy rate, and then I will release

microplastics and monitor the *Daphnia* under a microscope to see if they have consumed the microplastics. During this phase of the project, I will also assess how consuming microplastics affects their reproduction.

### 3) What do you hope to learn more about from this project?

I hope to learn more research techniques that could be useful to me as a medical professional. These techniques may seem tedious at times, but practicing them will ensure precision so that I can conduct clean and reliable experiments.

### 4) What are you looking forward to most about working on this project?

I am interested to see if we will find ARGs in the Las Vegas Wash, and I would like to see how they could potentially affect our environment and aquatic ecosystem. The Las Vegas Wash is also

*(Student Interview continued)*

connected to water treatment facilities, so it will be helpful to understand how our findings can improve water treatment processes.

**5) What are your goals for the next steps in your studies/ career?**

I would like to continue my research within the pharmaceutical research industry. I am interested in researching how drugs can be manipulated to target diseases such as cancer. I will have to use a lot of the techniques that I am learning in this lab to further understand how certain drugs work.

**6) Do you have a favorite dish that you like to make and why is it your favorite?**

I really enjoy making stuffed grape leaves. Although it's a very time-consuming dish, the outcome is well worth it. Plus, it has the benefit of being a healthy and delicious meal.

**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?**

I would want a professional camera to capture the beautiful scenes and important discoveries that I may run into on this island. Working for DRI has defiantly altered my way of thinking, so I would likely consider the interesting things that this island might reveal. I would also like to have a notebook to take notes, write about my experience, and maybe conduct a research project while I'm out there. ■



Algal cultures growing in treated municipal wastewater in an incubator under controlled conditions.

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*(PI Spotlight continued)*

planktonic crustaceans. “We are also working on detecting polyfluoroalkyl substances [PFAS] in the environment, which are a large group of synthetic chemicals used in many industrial products for firefighting, coating, and packaging,” Bai adds. “These substances are persistent in the natural environment and they can be carcinogenic if they become

highly accumulated in human bodies. We will then evaluate the mobility and transport of PFAS in the environment.”

Aside from her research interests, one of Bai's favorite things to do is spend time in nature. “When I can, I try to do outdoor activities, such as go hiking, at least once a week,” she says. When asked what one of her favorite movies is, she said:

“*The Pianist* is one of my all-time favorite movies. It's about how a Polish-Jewish pianist suffered through and survived the invasion of Poland during World War II.” ■



## Events Continued

2019 Fall Week of Water Events & Symposium  
September 23-26, 2019  
Reno, NV  
[www.nvwra.org/2019fallweekofwater](http://www.nvwra.org/2019fallweekofwater)  
[www.nvwra.org/2019-fall-symposium](http://www.nvwra.org/2019-fall-symposium)

SWITCH Tour  
September 23, 2019  
Reno, NV  
[www.nvwra.org/2019-sept-switch-tour](http://www.nvwra.org/2019-sept-switch-tour)

Operational Value of the Well  
September 26, 2019  
Reno, NV  
[www.nvwra.org/2019-operational-value-of-the-well-workshop](http://www.nvwra.org/2019-operational-value-of-the-well-workshop)

2019 Marlette Lake Water System Tour  
September 26, 2019  
Carson City, NV  
[www.nvwra.org/2019-marlette-lake-tour](http://www.nvwra.org/2019-marlette-lake-tour)

Chapman Conference: Large-scale Volcanism in the Arctic - The Role of the Mantle and Tectonics  
October 13-18, 2019  
Selfoss, Iceland  
[connect.agu.org/aguchapmanconference/upcoming-chapmans/arctic-volcanism](http://connect.agu.org/aguchapmanconference/upcoming-chapmans/arctic-volcanism)

Chapman Conference: Winter Limnology in a Changing World  
October 14-18, 2019  
Polson, MT  
[connect.agu.org/aguchapmanconference/upcoming-chapmans/winter-limnology](http://connect.agu.org/aguchapmanconference/upcoming-chapmans/winter-limnology)

Chapman Conference: The Quest for Sustainability of Heavily Stressed Aquifers at Regional to Global Scales  
October 21-24, 2019  
Valencia, Spain  
[connect.agu.org/aguchapmanconference/upcoming-chapmans/aquifers-sustainability](http://connect.agu.org/aguchapmanconference/upcoming-chapmans/aquifers-sustainability)

AWRA Annual Water Resources Conference  
November 3-7, 2019  
Salt Lake City, UT  
[www.awra.org/Members/Events\\_and\\_Networking/Events/ANNUAL\\_WATER\\_RESOURCES\\_CONFERENCE.aspx](http://www.awra.org/Members/Events_and_Networking/Events/ANNUAL_WATER_RESOURCES_CONFERENCE.aspx)

2019 ASA-CSSA-SSSA International Annual Meeting: Embracing the Digital Environment  
November 10-13, 2019  
San Antonio, TX  
[www.acsm meetings.org/](http://www.acsm meetings.org/)



Groundwater Week  
December 3-5, 2019  
Las Vegas, NV  
[groundwaterweek.com](http://groundwaterweek.com)

AGU Fall Meeting 2019  
December 9-13, 2019  
San Francisco, CA  
[meetings.agu.org/fall-meeting-2019/](http://meetings.agu.org/fall-meeting-2019/)

2020 NWRA Annual Conference Week Activities  
February 10-13, 2020  
Las Vegas, NV  
[www.nvwra.org/2020-annual-conference-week](http://www.nvwra.org/2020-annual-conference-week)

AWRA Spring Conference: Geospatial Water Technology Conference: Complex Systems - Tribute to David Maidment  
March 23-26, 2020  
Austin, TX  
[www.awra.org/Members/Events\\_and\\_Networking/Events/Spring\\_2020\\_Specialty\\_Conference.aspx](http://www.awra.org/Members/Events_and_Networking/Events/Spring_2020_Specialty_Conference.aspx)

## 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.*

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[www.dri.edu/nwrri](http://www.dri.edu/nwrri)

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Banner photo: Sand Harbor at Lake Tahoe by DimiTalen [CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)]

Page 5: A micrograph of an adult *Daphnia magna* by Dita Vizoso [CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)]

Events list, page 7: Beaver dam on Blackwood Creek, a tributary to Lake Tahoe by Schmiebel [CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)]