# FRIENDS of *Great Salt Lake*

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*Long-billed Dowitcher* by Brookelynn Harris

The mission of FRIENDS of Great Salt Lake is to preserve and protect the Great Salt Lake ecosystem and to increase public awareness and appreciation of the lake through education, research, and advocacy.

# Executive Director's Message

## Water Resource Pressures and Climate Change Must Be Considered Even If We Can Narrow the Differences on a Proposed Expansion on the Lake

**9/7/13~current lake level 4194.8'**

There is no question that expansion of minerals extraction on the Lake poses a threat to the Lake ecology and functional use for everyone, especially in its current low level state. As with all resources, prudent and responsible management is required to sustain that resource for the benefit of all concerned. As sailors, our first concern is how deep is the water.

-Jerry Harwood, Rear Commodore, Great Salt Lake Yacht Club

The summer of 2013 was brutal. In Salt Lake City, temperatures reached 95 degrees or higher on 52 days. As the West continues to experience widespread impacts from another perennial drought, the U.S. Bureau of Reclamation made history by announcing that water releases from Glen Canyon Dam would be cut. The U.S. Department of Agriculture declared all 29 counties in Utah to be either "at risk or a disaster area." And since May 1st, the elevation of Great Salt Lake hovered in a narrow range between 4196' – 4194.8' . That's a range characterized by the Division of Forestry, Fire and State Lands (DFFSL) in its Great Salt Lake Level Matrix as a transition zone where boating, brine shrimp harvesting, and salinity exchange between the North and South Arms begin to experience impacts.

These conditions set the stage for a series of water hearings that Governor Herbert scheduled around the State to gauge public opinion on the use, development, and conservation of water in Utah. In theory, the hearings would inform the administrative and legislative development of policies and practices that would curtail our gluttonous water habits. In Lake terms, with increased water demands and decreased snowpack, FRIENDS is concerned that Lake levels will trend downward permanently. In fact, experts have discussed lowering what is referred to as "average" Lake level (4,200') to reflect this trend. Let's hope that the consensus of expression from the hearings reflects a serious concern about the role climate change is playing in the Great Salt Lake watershed.

But what does this have to do with a revised expansion proposal from Great Salt Lake Minerals Corporation? And how is it relevant to Great Salt Lake as a Public Trust that belongs to all of us?

Great Salt Lake Minerals Corporation (GSLM) is one of 6 mineral extractive industries on Great Salt Lake. It's North America's largest producer of potassium sulfate - a commercial fertilizer. It currently operates 45,000 acres of solar evaporation ponds on the Lake, divided almost equally between Bear River Bay in the northeast corner of the Lake, and Clyman Bay to the west in the North Arm.

Potassium sulfate extraction begins in the North Arm where salinity levels are near saturation (approximately 26%). Lake water is pumped into a series of evaporation ponds where it undergoes preliminary evaporation during which selected salts drop out and remain in the Clyman Bay ponds. The rest of the brine is pumped across the Lake in the Behren's Trench to the Bear River Bay facilities where potassium sulfate is harvested. GSLM processes about 6 million tons of salt per year. Approximately 4.5 million tons of unsalable excess salts are flushed back into the southern portion of Bear River Bay and make their way into the open waters of the Lake.

On July 9, 2013, GSLM submitted an amended permit application with the U. S. Army Corps of Engineers for a revised expansion proposal. The company wants to increase its production of potassium sulfate by expanding the footprint of its existing evaporation pond complex. Under the Clean Water Act, a 404 permit is required because of impacts to waters of the U.S. (Great Salt Lake) and wetlands. An Environmental Impact Statement (EIS) is also required.

The good news about the 2013 plan is that GSLM has worked in earnest with the conservation community to modify its earlier 2009 proposal. This modification is a testament to the company's willingness to sit down and address some of our major concerns with the expansion. Although this proposal suggests significant reductions in the scale of the expansion and additional water needs, the Lake isn't out of the woods yet. The Lake ecosystem is already under stress, relying on precipitation, instream flows and water remaining within the system for its viability. Changes in any of those can alter the Lake's ecosystem.

Let's compare the two expansion plans so you can understand what has changed and what the potential impacts to the system are.

In the original 2009 proposal, GSLM wanted to expand its operations by 91,000 acres - 8,000 of those acres in Bear River Bay (designated an Important Bird Area by National Audubon Society because of its unique habitat value and high bird use). In conjunction with more dikes and evaporation ponds that would cover the surface of the Lake (and can influence surface evaporation), the project would consume an additional 353,000 acre feet of Lake water annually. This is above the 150,000 acre feet the company currently uses.

Now things look quite different. The 91,000 acres is reduced to 37,497. This was achieved in part by the acquisition of a SITLA (School Institutional Trust Lands Act) lease parcel of 24,000 acres consisting mostly of uplands (15,000 acres). No development in Bear River Bay will occur. The application for the 353,000 acre feet of Lake water was withdrawn. Salts sequestered in the Clyman Bay ponds will be moved back into the

Lake using a progressive reclamation approach. And if approved by the Corps, the physical expansion would occur in three 8-10 year phases based on monitoring, data collection, and evaluation through an adaptive management approach. The public will have an opportunity to comment at each stage to help determine whether the next phase of expansion can go forward.

This is all very positive. These changes reflect GSLM's goal to minimize impacts to the Lake but only because FRIENDS and other partners in the Coalition to Keep the Lake Great objected strongly to the original proposal. So why do we still have concerns if the proposed expansion is now smaller and the additional water right is not needed?

Great Salt Lake is a Public Trust resource that belongs to the people of Utah. The Division of Forestry, Fire & State Lands (DFFSL) has jurisdictional responsibility to manage the Lake sustainably and in perpetuity for future generations. Since 2009 when GSLM first proposed its expansion, we have gained tremendous insight about the Great Salt Lake Ecosystem thanks to some new tools at our disposal.

These tools include two 2012 reports from the Great Salt Lake Advisory Council. The first, Economic Significance of the Great Salt Lake to the State of Utah, tells us that the Lake contributes $1.3B annually to the economy of Utah and provides over 7,700 jobs. The second report, The Definition and Assessment of Great Salt Lake Health, evaluated various ecological targets that comprise the Great Salt Lake ecosystem to determine their particular state of "health or viability." Many of those targets face stresses which the study ranked high to very high. A key contributor to those stresses is reduced Lake levels that cause a variety of impacts to the system such as changes in salinity, increased vulnerability to island nesting birds, the proliferation of phragmites, and stress to brine shrimp populations.

But probably the most instructive tool is the Great Salt Lake Level Matrix, which emerged from the most recent revision process of the Great Salt Lake Comprehensive Management Plan (GSLCMP). It's the Lake's Rosetta Stone that provides a schematic perspective on volumes of water in the Lake, how that translates into a range of Lake elevations, and in turn, how physical features, ecological targets, and ecosystem services are impacted. The Matrix classifies a low Lake level as 4,188' – 4,197'. This brings us back to GSLM's proposal, mineral extraction in general, and existing consumptive water rights on the Lake.

It's important to remember that Great Salt Lake does not have a water appropriation or water right for its own beneficial use. For an ecosystem that is both hemispherically important to millions of migratory birds and brings in billions of dollars each year to the economy of Utah, this is a problem. At our 2010 Great Salt Lake Issues Forum we talked about keeping the Lake wet. One strategy to achieve this would be to establish a conservation pool for the system. To sustain the array of uses and ecological targets for a viable system, all consumptive water right withdrawals would be curtailed at a specific Lake level. New proposals for Lake uses would be tabled and existing water uses would be significantly scaled down until Lake levels go back up. Reservoirs use this same principle.

According to the Matrix, at an elevation of 4,194' there are 10.2 million acre feet of water in the Lake. At 4,193' there are only 9.6 million acre feet – a 600,000 acre feet difference. The revised GSLCMP indicates that there are 334,845 acre feet of perfected water rights held by mineral companies on the Lake, and approved but undeveloped rights of over 300,000 acre feet. If the Lake elevation was at 4,194' and all of the perfected and approved water rights were consumed, the elevation of the Lake would drop a full foot to 4,193', flows between the North and South Arm would cease, and Gunnison Island – an American White Pelican rookery where birds are protected by surrounding water – would become accessible by land to predators. Note that although GSLM has withdrawn its application for this additional 353,000 acre feet of water the net consumption of water by the company at low Lake levels will increase over time as will the likelihood that at levels below 4,195' resources will be impacted.

In our comments to the Corps on the 2013 expansion proposal, FRIENDS and Coalition members stated that if the proposal is approved, then brine extraction by GSLM should cease when the Lake level is at 4,194'. That should also be the case for all water consumption of our Lake. Remember the conservation pool idea.

This is just one example of water resource pressures on the Lake. While it is becoming obvious to many of us that we need to stop withdrawing water from the Lake at low Lake levels to avoid a tragedy of the commons, it continues to be a political nonstarter. FRIENDS believes there is no other choice. We must work to achieve solidarity with Lake users and upstream users to preserve and protect our Public Trust for future generations. In the words of Hunter S. Thompson,"When it comes to things like this, you don't fool around."

In saline,

Lynn

For a full discussion, see www.fogsl.org

# Friends Organizational Statement

FRIENDS of Great Salt Lake is a membership-based non-profit 501c3 organization founded in 1994. The mission of FRIENDS is to preserve and protect the Great Salt Lake Ecosystem and to increse public awareness and appreciation of the lake through education, research, and advocacy. The long-term vision of FRIENDS is to achieve comprehensive watershed-based restoration and protection for the Great Salt Lake Ecosystem.

FRIENDS has a very active Board of Directors and an Advisory Board consisting of professionals in the scientific, political, literary, eduction, and broadcast communities. The organization sponsors an array of programs, activities, and materials in pursuit of its mission.

Every two years, FRIENDS hosts the Great Salt Lake Issues Forum to provide a focused discussion about the Lake for policy makers, researchers, planners, industry and other stakeholders. The goal of each Forum is to encourage constructive dialogue about the future of the lake's ecosystem and its resources, and to illuminate the complexities involved in research, management and planning for the lake.

The Friend of the Lake award, given at each forum, acknowledges a citizen, business or organization working to promote Great Salt Lake awareness in the community.

In 1997, Bruce Thompson was hired as Education Director to initiate a regional education project designed to enhance both the knowledge about and care for the future of Great Salt Lake. Bruce wrote and produced a live-narrative slide-show program "The Lake Affect: Living Together Along the Shores of Something Great." The program is now available on DVD.

In 1998, the Utah Chapter of the Wildlife Society awarded FRIENDS the Conservation Achievement Award..

In 2000, Project SLICE, a 4th grade curriculum using Great Salt Lake as a system of study, was initiated. The Lakeside Learning field trip program, a component of SLICE, continues to grow.

In 2002, the Doyle W. Stephens Scholarship Award was established. The scholarship provides support to undergraduate and graduate students engaged in new or on-going research that focueses on Great Salt Lake.

In 2002, Lynn de Freitas was awarded the outstanding volunteer educator award by the Utah Society for environmental Education.

In 2006, FRIENDS was the recipient of the Calvin K. Sudweeks Award from the Utah Water Quality Board for outstanding contibutions in the water quality field.

Andrea Nelson, hired in 2012 as Education & Outreach Director, is working to expand education outreach into the Great Salt Lake community.

Kristin Liszkowski, hired in 2013 as Membership & Development Director, is working to raise funds and write grants to expand the reach of FRIENDS.

## On the Cover

Long-billed Dowitcher by Brookelynn Harris

The Long-billed Dowitcher is one of the many birds living in the area of the Great Salt Lake. It is a unique creature, impossible to recreate perfectly with paper and pencils. When I first found out that this is the bird I was asked to draw, I wasn't overly excited. I had never even heard of it, and it looked dull. Why were they asking me to draw this? It didn't look interesting at all. Where were the colorful, vibrant feathers? But as I started to draw the mixture of caramel, chocolate, and vanilla, it felt like more than just a dull bird to me. It's a good protector, has a family, has a life. And a wonderful addition to this place that we get to enjoy living by. This bird could not be replaced. As I did my best to capture this bird in a picture, I came to appreciate life in Great Salt Lake and all that the joy of nature gives us.

Brookelynn Harris, was a 6th grader at Legacy Elementary School in American Fork and winner of Best of Show at the 2013 GSL Bird Festival

# A Member of the American Beaver Corps of Ecosystem Engineers

*American Beaver* by Karri Smith

# Water Summit/Water Policy/Water Future

## Water Hearings Draw Crowds and Policy Ideas

Hearings on "Utah's Water Future" were attended by hundreds of Utahns across the state this summer as the Governor's office asked for ideas and solutions about the use, development and conservation of water in the state. Comments will be analyzed by the Governor's staff, with the process culminating in a Water Summit October 30 in Provo.

Each of the hearings had its own distinct flavor and focus, with agricultural concerns paramount in central Utah, while the need for much stronger conservation efforts was an overarching theme in hearings along the Wasatch Front.

Citing its important wildlife, recreation and economic values, Great Salt Lake advocates urged support for funding for the Integrated Water Resource Management Model and other research for the Lake, for measures like a conservation pool to assure that the Lake doesn't drop to levels that harm bird habitat and curtail recreation access, and against projects that encroach upon the shorelands or degrade the water quality and ecological resources of the Lake.

On the way to the Bear River Migratory Bird Refuge by L. de Freitas

The conservation community staked out its positions urging more market-based water pricing, with progressive rate structures to encourage wise use of water, and its opposition to elaborate, expensive and environmentally destructive water development projects like the Lake Powell pipeline, Bear River dam/diversion project, and the Las Vegas "Water Grab" in Utah's Snake Valley.

As the second driest state in the nation, Utah lags well behind its western neighbors in water conservation. Yet conservation is the most effective and least expensive strategy, so big savings can be realized with relatively painless changes. Groups like the Utah Rivers Council argue for reducing the property tax subsidy of municipal water rights so users will know the real cost of water. Programs to help households buy water-saving appliances, farmers to convert to more efficient methods, and canal companies to line or pipe their water - all must be part of the new conservation portfolio.

Perhaps Utah's – and the West's - biggest challenge is the shrinking Colorado River, primary water source for over 40 million Westerners. As climate change accelerates, business as usual, with states scrambling to develop their allocated share of the already over-appropriated River, simply can't continue. This new, drier era requires new solutions be examined. Joint ventures in water banking or leasing water from the Upper Basin to Las Vegas, for instance, filling Lake Mead first, or building desalination plants on the coast in exchange for River water upstream should be on the table.

While we remain concerned the summit process may become mostly a vehicle for building public and legislative support for financing big water supply projects, we remain guardedly optimistic that this process will yield positive, progressive results that will indeed help secure Utah's water future.

*Steve Erickson is the Policy Advocate for the Utah Audubon Council and the Utah Coordinator for the Great Basin Water Network*

# It's Our Way or Their Freeway

## Why We Need the Shared Solution for West Davis

The West Davis Freeway (WDF) is 20 miles of proposed new freeway in western Davis County. A product of 1950s mania for large scale automobile investments, the WDF has been on the books for over 50 years. But with the recent release the Draft Environmental Impact Statement, the road became a project with real prospects. UDOT plans for a spring 2014 decision that would assure the road's construction.

When imagining the proposed freeway, many residents of the Wasatch Front envision the Legacy Parkway--a 55 mile per hour, truck and billboard-free road paired with a scenic, multi-use trail, complete with aesthetic bike crossings. In reality, the proposed freeway has almost nothing in common with the popular parkway. The proposal is a high speed truck and car corridor paving over farmland, wetlands and homes that will become little more than a road to sprawling gas stations, big box stores, and new auto dependent homes.

The Shared Solution, an alternative to this proposal, has been developed by community and public interest groups. The Shared Solution is physically, economically, and philosophically distinct from a freeway--instead of a single, $600 million dollar investment, the Shared Solution utilizes existing infrastructure to identify strategic points and corridors in west Davis for street, intersection, and land use improvements. The goal is to maintain quality of life for existing residents, preserve critical farms and wetlands, and develop job and housing opportunities for a growing population. Combined with predictable, affordable shuttles to Front Runner, the Shared Solution means supporting a variety of lifestyle choices in west Davis without destroying what makes that area special.

If you ask a UDOT representative why they are proposing a new freeway, you are bound to hear some form of the same answer: a freeway in west Davis is necessary because automobile congestion will be so horrendous in 2040 that it will cost us hundreds of thousands of dollars a day in lost productivity. The supposed inevitability of this intolerable automobile congestion is a product of a transportation demand model—a complex algorithm that takes in information about lane miles and population and spits out minutes of automobile delay. But models are not the only tool we have for predicting the future; and freeways do not have to be our answer to that future.

There are many reasons this road is a bad idea. According to regional travel modeling, the road will have excess capacity even in 2040. Furthermore, only a miniscule portion of the population would stand to benefit from a road so far from the I-15 activity corridor when jobs are still predominantly located in Salt Lake County. Any development that would be seen along this new freeway would be standard American sprawl—big box stores, gas stations and auto-dependent homes.

Furthermore, freeways create deep divides in human communities--they are literal barriers to active transportation and cultural divides between different sides of town. Freeways also spell huge loss for our non-human neighbors—paving over critical wetlands and dividing habitat. Realizing these myriad impacts, many American cities are actually tearing down their freeways in favor of street-level improvements such as multi-use boulevards.

A growing number of people are recognizing that new highway in west Davis is a huge investment in a future we don't want. We need visionary ideas, grown from within our communities, which prioritize our values. The Shared Solution is one such plan and we need your support to realize it. If we are to avoid the madness that is the West Davis Freeway, we must unite as communities and demand a future that respects who we are and who we want to become.

*Renae Widdison is part of the Shared Solution Coalition--a growing network of community and public interest groups working to advance the Shared Solution as an alternative to a highway in west Davis County.*

Find out more and lend your support at
**SharedSolution.org**

Shared Solution rally by Ann Floor

# A View from the Uplands

**AP • O • PLEC • TIC**

1 : of a kind to cause or apparently cause stroke (an apoplectic rage); also : greatly excited or angered (was apoplectic over the news)

Apoplectic is probably the best word to describe behavior of about two dozen adult avocets and black neck stilts as I and fellow photographers John Blumenkamp and Mark Summers snapped photos of three small avocet chicks; chicks that were hatched on upland adjoining the Great Salt Lake Wetlands. The adults were feigning, threatening, buzzing, flapping, hopping, squawking, screeching and doing everything in their collective and individual instincts to distract us from the chicks. It was a circus of bird antics with all the stops pulled on the calliope.

Oh, and get too close to a killdeer nest and you may witness the ultimate in apoplectic bird behavior; the Killdeer Fandango.

While the GSL itself and the wetlands bordering it get top billing and thus deserve our energies to preserve them, we often forget about the neighboring uplands that provide nesting grounds for thousands of avocets, stilts, curlews, plovers, willets, ducks and other birds. With a major portion of the world's cinnamon teal nesting on these uplands, they are just a critical as the wetlands they border.

American Avocet chick by Steve Earley

Killdeer feigning injury by Steve Earley

The uplands I am most familiar with are those located on the 3,000-acre upland and wetland complex know as the Ambassador Duck Club which is located just a few miles northwest of the Salt Lake International Airport. Uplands and wetlands I visit nearly every week of the year.

At these uplands, spring is announced every year not just with the arrival of waterfowl but with the arrival of adult long-billed curlews. This year, we have approximately a dozen pairs of curlews nesting on our uplands. Their brown plumage blending perfectly with the grasses that turn brown in early summer; thus providing perfect camouflage for both adults and chicks. The arrival of eggs to the nest and hatched chicks is further announced with squawking and cackling by flying, walking and running adult curlews as they seek to lead you away from their nests or at least annoy you enough that you'll want to get somewhere else where it's quieter. Bring a dog along on your walk and you'll know why I use the term apoplectic.

Lest you think because you are in upland you don't have to worry about mosquitoes, think again. As you carefully walk through these uplands, you'll be swarmed by mosquitoes and other insects that provide needed protein for chicks and adults alike. Indeed, to escape the mosquitoes you are better off well away from shore in the water than along the shore or in the uplands.

Along with the special treat the curlews bring are the glaring yellow/green eyes from adult burrowing owls. With about six active dens on our property, these little yellow fellows seek high points on our rolling uplands unlike the curlew who like the flat grassy areas. Add some bushes to either the flatland or hillocks and you are likely to find nesting willets.

The uplands don't just benefit nesting birds in the spring time either. These same uplands provide food sources for local and migratory raptors who feed on mice and other small mammals that inhabit the uplands. Last winter's harsh temperatures, combined with an ice cap on the snow from the January ice storm, made the world of mice and voles safe but resulted in all our barn owls starving to death. Harriers last winter simply disappeared and have yet to return.

Enjoy the uplands and let's remember them as equally important in our conservation efforts.

*Steve Earley is a member of the Ambassador Duck Club and owner of Trek the wonder dog.*

Long-billed Curlew by Steve Earley

# Protecting America's Waters

## Through Education and Through Partnerships


Big smiles after airboat ride on Willard Spur, GSL by Margie Nash

When high school students analyze data they have collected in the field, light bulbs go on. The data is real and it is their data. The act of collecting and connecting promotes a deeper understanding, which in turn contributes to complex thinking. The process of analyzing the data is organic and meaningful which leads to new questions and inquisitions.

We are working with a group of Highland High students to test water quality at a Parleys Creek site and one in Tanner Creek. The EPA has funded a program to enhance environmental literacy by providing high quality education across, and integrated with, core disciplines. It's a partnership between a formal classroom teacher and a non-formal environmental educator. FRIENDS is the grantee and informal educator and Highland High's Advanced Placement Environmental Studies and AP Chemistry instructor is the formal educator. We also joined forces with Brian Greene, the Utah Water Watch Program Coordinator at USU Water Quality Extension Office and Jodi Gardberg the Utah Division of Water Quality's Great Salt Lake Watershed Coordinator.

Brian trained the students and provided the necessary equipment and materials. Jodi spent a day with us at the Lake allowing the students to see and discuss scientific studies being conducted on the Lake. The day was capped by an airboat ride around Willard Spur, coutesy of Utah Airboat Association members. We were able to stop long enough to capture carp lazing around in the area.

The students collected water quality data for four months from the two selected sites. This temporal aspect enabled the students to view not only the static water quality of the sites but to examine the changes that occur as time passes. They also had the opportunity to explore the terminal end of their stream flow at the Great Salt Lake. This reminded them that everything that flows through the watershed ends up at one location. Hence the concentrations of some substances such as mercury become highly concentrated when they accumulate in a terminal lake.

All of these concepts can be presented in a lecture format in the classroom but until they are real to the student, the concepts will have very little impact on their deep understanding of how the world actually works. This study and the use of scientific processes revealed the chemistry, biology and mechanics of watershed action to the students.

For the rest of the year our students will be outdoors and engaged with water, both the fresh and the salty kind. And, without a doubt, as partners in this effort we are leaving our work and legacy in very talented and capable hands.

*Margie Nash coordinates the grant for FRIENDS of GSL. Monica French teaches Advanced Placement Environmental Science and Chemistry at Highland High School.*

This project was funded by the U.S. EPA Environmental Education Program through the Utah Society for Environmental Education.

# Brine Shrimp Family Tree

## Working to Determine Genetic Diversity of Great Salt Lake Brine Shrimp

One of my main jobs in life is to convince people that brine shrimp are interesting. Whenever I get the chance, I extol the virtues of our neighbor, Artemia franciscana, the under-appreciated arthropod from Great Salt Lake. Did you know that they are the only animal that spends their entire life in the water of the Lake? I didn't before I moved to Salt Lake City eleven years ago to teach at Westminster College. I was looking for an interesting system to study using the genetic tools that I had learned in graduate school, and over the years I have convinced several students and others that understanding more about brine shrimp is a worthy cause.

Recently, we have made some progress studying brine shrimp and their parasites using DNA-based molecular biology techniques. One question that we are asking is "How genetically diverse is the Great Salt Lake brine shrimp population?" Typically, most individuals of the same species that live in the same lake would be assumed to exist as a single, not very diverse population. However, brine shrimp live in very salty water, which increases the rate of natural changes that happen in their DNA (also known as their mutation rate) which increases their genetic diversity. In addition, the railroad causeway that bisects the lake creates distinct conditions on either side that may select for genetic differences in brine shrimp that live there. So it is possible that we might have two genetically distinct populations living in Great Salt Lake.

In collaboration with the Great Salt Lake Ecosystem Project of the Utah Department of Wildlife Resources we are currently studying the genes from shrimp from a few sites from the North and South Arms of the Lake to determine whether we have a single population or, perhaps, more. It will take us a few years to understand any differences among the different samples we have collected, but we think it represents an interesting example of how Great Salt Lake, and the organisms that inhabit it, are special, and worthy of more attention.

Another interesting aspect of brine shrimp biology that my students and I study is a host-parasite system, where the shrimp serve as the intermediate host for cestode (tapeworm) parasites that ultimately infect the birds that feed at Great Salt Lake. These tapeworms hatch from eggs laid into the water of the Lake and infect brine shrimp using them as a vehicle to get back into the guts of birds when the birds eat the shrimp. Again, we have used DNA-based molecular biology tools to identify 2 different cestode parasites within the shrimp and we have designed a DNA-based, polymerase chain reaction (PCR) assay to test whether individual shrimp are infected with one of these parasites. So far, between thirty and forty percent of the shrimp from our sampling sites in the South Arm of the Lake test positive for cestode DNA, while very few from the North Arm are positive. We are very interested in following up on this difference and understanding possible causes.

Hopefully, I have convinced you that the biology of the brine shrimp Artemia is interesting and maybe the next time you are at Great Salt Lake you'll see brine shrimp in a new light.

*Brian Avery is a Professor of Biology at Westminster College*

Great Salt Lake sampling by Brian Avery

# Great Salt Lake Education

## Year 'Round Learning Opportunities Can Always Be Found at the Lake

When it comes to Great Salt Lake education our work never ends. Since early summer to the completion of our Fall Lakeside Learning Field Trip season in late September our FRIENDS of Great Salt Lake Education Team has been whammin' and jammin' with all things briny.

June and July were spent preparing for and conducting our Great Salt Lake Summer Camp with our partners the Utah Museum of Natural History. This is our second year of offering a summer camp experience for school aged kids who are looking for something exciting and unusual to do during their summer break.

This year, we offered two week long camp experiences. Each special. Each fun. We climbed to the top of Ensign Peak to take in the big picture view of the Lake and its surrounding wetlands. We sampled for macroinvertebrates at City Creek, which everyone knows eventually finds its way to the Lake. Back on the valley floor, we ventured out to Farmington Bay where we did more sampling to make comparisons with the critters there. Floating in super-saline waters always brings down the house. And then up to our state- of- the-art Natural History Museum of Utah to explore the weird, the cool, and the fantastic stories that Great Salt Lake has to share.

Keep your eye on the Natural History Museum of Utah's Summer camp webpage: http://nhmu.utah.edu/summercamp if you happen to know a 3rd or 4th grader who enjoys getting their feet wet in Great Salt Lake.

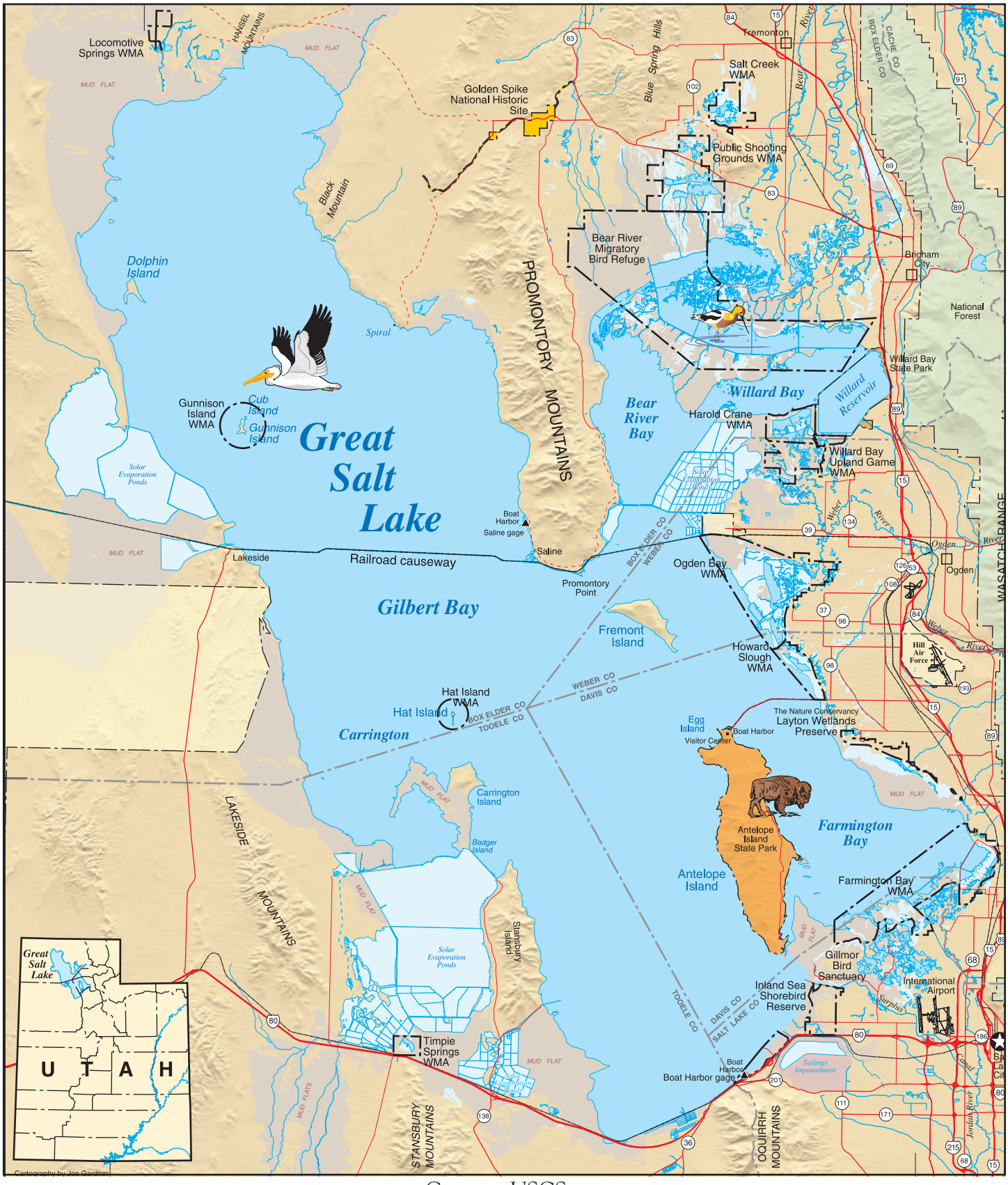
We just finished our fall Lakeside Learning Field Trip Season with pizzaz! 800 students, parents and teachers were able to experience the "always unique and always fascinating topic of dinner conversation" discovery of this world famous and hemispherically important ecosystem. Fall is an especially great time to visit the Lake and Antelope Island because the weather is just a wee bit more stable than springtime. And there are no biting insects, which we know does not include brine flies because they don't bite.

Want to know more? Want to volunteer? Want to bring your class to this world class place? Contact me at pelican@fogsl.org

Andrea Nelson, Education and Outreach Director

Antelope Island Naturalist Wendy Wilson and 4th-graders by A. Nelson

# Great Salt Lake At A Glance




Courtesy USGS

# Dr. Ephydra - We Welcome Your Questions Via Email or Phone

E • phy' • dra, a noun; a genus of two species of brine flies that live on the bottom of the Great Salt Lake as larvae and pupae, and along the shores of the Lake as adults.

## The Role of Bacteria in the Cycling of Contaminants in the Great Salt Lake Ecosystem

The Great Salt Lake (GSL) and its surroundings carry tremendous economic and ecological benefits to the people of Utah. It is a terminal lake (no outlet), and receives discharges from various sources. The Great Salt Lake Ecosystem is particularly interesting because of the salinity gradient which can be attributed to the presence of causeways. This gradient also drives the way the Lake is managed by the State of Utah. The Great Salt Lake Ecosystem is contaminated with mercury, selenium, and nutrients among other pollutants. The wetlands surrounding the Great Salt Lake are important to millions of migratory birds that stop at the Lake to rest, stage and nest. And the Lake is also very important to the local economy, especially in terms of brine shrimps harvesting.

The GSL Ecosystem receives discharges from three major rivers (Bear, Weber/Ogden and the Jordan), industries along its shores, and final effluents from some local wastewater treatment plants. The primary output of water from the Lake is in the form of evaporation. These inflows and outflow maintain the water balance in the GSL ecosystem. From a water quality standpoint, because of the salinity gradients that exist in the system, fresh water quality criteria do not apply to the system. However, several water quality problems pose a great threat to the Lake and have the potential of affecting food chain, migratory birds, flora and fauna that exist there. It is because of these potential threats that monitoring and research efforts are being identified to determine water quality standards for the Lake. Currently, the only numeric water quality standard that exists for the Lake is for selenium. This standard only applies to the open waters of Gilbert Bay and is based on a bird egg tissue standard. The standard was established in November 2008 in the UAC R317-2-14 (Utah Administrative Code).

Contaminants of concern in the Lake include nitrogen, phosphorus, metals such as mercury, selenium and arsenic. At several locations, these contaminants co-exist and make the monitoring and management efforts more challenging. The presence of nutrients in any surface water body supports the growth of submerged vegetation and other phytoplankton and thus, can create adverse conditions. The nutrient supported growth of blue green algae (cyanobacteria) can cause secondary problems associated with the production of cyanotoxins by blue green algae. Mercury is a contaminant of great concern in any ecosystem due to its ability to convert into methyl mercury, which can bioaccumulate in animal and human tissue. Numerous efforts are in place by local regulatory agencies and universities to understand the fate and dynamics of these contaminants in the Lake's ecosystem.

Bacteria and archaea, collectively known as prokaryotes (single-celled organisms) are important components of any ecosystem and are known to participate in nutrient and metal cycling. For example, more than 50% of nitrogen gas present in the atmosphere is a result of a bacteria mediated anaerobic process that occurs in marine and other aquatic sediments. Bacteria participate in many metabolic processes such as ammonia oxidation conversion to nitrogen gas, metal sulfide formation, and mercury conversion to methyl mercury. These processes have been thought to be occurring in Great Salt Lake but very few efforts have actually focused on finding the rates at which these tiny yet important creatures carry out these metabolic activities. The functionality of any aquatic ecosystem also depends upon

**Table 1.** Total and Methyl Mercury in Sediments in Turpin Dike Unit of the Waterfowl Management Area

| Site | Analyzed Result (µg/Kg) THg (Wet Wt. Basis) | Analyzed Result (µg/Kg) MeHg (Wet Wt. Basis) |
|---|---|---|
| 1 | 51.90 ± 17.89 | 0.11 ± 0.02 |
| 2 | 78.07 ± 5.03 | 0.86 ± 0.65 |
| 3 | 51.43 ± 13.48 | 0.07 ± 0.01 |

several microbial processes occurring simultaneously and these processes eventually lead to changes in root zone in wetland vegetation, surrounding sediments and in the water column. Some important prokaryote mediated processes in the Great Salt Lake include nitrogen cycling through biological nitrogen transformations, mercury methylation, bio-p accumulation inside bacterial biomass, cyanobacteria growth leading to cyanotoxins production and many more, albeit a complete understanding of these processes is still missing in GSL ecosystem.

For the past 6 years, Dr. Ramesh Goel's laboratory in the Civil & Environmental Engineering Department at the University of Utah has been researching nutrient and mercury dynamics in Utah waters including Utah Lake, the Jordan River and Great Salt Lake and its surrounding wetlands. In 2008, Dr. Goel's lab developed an ultra liquid chromatography based detection method for nodularin, a commonly produced cyanotoxin by blue green algae in brackish waters. The analytical method was verified by spiking Lake and pure water samples with pure compound of nodularin and then subjecting these water samples to the same extraction and measurement protocols that were used for the actual water samples. This rigorous analysis showed the concentrations of cyanotoxins measured in all the samples at all locations in Farmington Bay were below detection limit during that particular year. These results were verified by molecular fingerprinting of cyanobacteria in which case, DNA based cyanobacteria specific biomarkers were used to profile the cyanobacteria community in collected water samples. The molecular analysis did not show the presence of Nodularia spumigena, a known brackish water cyanobacteria. Table 1 shows total and methyl mercury concentrations at three different sites in Turpin Dike unit of the Farmington Bay Waterfowl Management Area measured in Dr. Goel's lab using EPA approved method.

The mercury methylation rates at sites 1, 2 and 3 based on 12-hour batches were estimated to be 0.0302 Day-1, 0.0082 Day-1 and 0.021 Day-1 respectively, with variations owing to the actual kinetic rates than the variation in the sample conditions. The three sites were located in very close proximity to each other. Hence, it is interesting to note the wide differences in the rates of methylation at these three sites. These results indicate that Farmington Bay sediments, at least at some locations, are active for mercury methylation and should be evaluated further.

The use of molecular biology tools employing DNA technology directly has the potential of making significant contribution to ongoing monitoring and management efforts in Great Salt Lake. Several key processes mediated by bacteria are important in the Lake's ecosystem and hence, understanding the rates at which these processes occur on the one hand and understanding the type of functional genes involved on the other hand also have the potential to compliment the modeling efforts, especially in the area of metabolic models.

Bacteriology provides a common platform to address several simultaneous processes occurring in the Great Salt Lake Ecosystem. The findings can lead to the construction of metabolic models which can be integrated in the overall water quality and water balance budget of the Lake in the future. Metabolic rates obtained through such approaches may help regulatory agencies to evaluate the potential of contaminants to partition into the food chain. Future research related to Great Salt Lake should also include microbial diversity and microbial mediated rates because these are important to evaluate the sustainability of any ecosystem to handle contaminant loading.

*Dr. Ramesh Goel is an Associate Professor of Civil & Environmental Engineering at the University of Utah*

Lucin cutoff trestlewood by Michael Slade

# Discovering Our Lake

## Saving the Wet Ones

We know that we live on a water planet, and that without water and plant life we would not be here. We are aware of the purification and restoration value that wetlands and similar places naturally provide. And, we know the extent to which wildlife depends on reliable drinking sources, and that the greatest diversity of life inhabits places with nearby springs, babbling brooks, riparian corridors, wet meadows, hummocks, fens, bogs, as well as places more typically thought of as wetlands where cattails, bulrush and arrowleaf almost always have their feet wet.

And yet, which of our places are the most threatened and generally the least respected? The wet ones.

These delicate, fragile ecosystems often tend to be flat. We tend to build on flat places. They provide a source for water and entice us with their beauty. So, we tend to live by them. And as we aggregate and accumulate in our numbers and expand around them, we slowly absorb them and ultimately forget that they were even there.

Today in much of northern Utah along the Wasatch Front we have only the table scraps of what once was. And of our continued vanishing flora and fauna, it is the wet places that have suffered the most from pollution, exotic species, poor land management practices including overgrazing, urban sprawl that has not properly considered the need for natural open space, and the loss of buffer zones and contiguous habitat remnants to recognize wildlife migrations by land and by air that have occurred for centuries.

Instead, "they" really did pave over paradise and put up a parking lot such as at the Meadowbrooks Trax station in the Salt Lake Valley very near to which a rare orchid once grew. Rare orchids however do not simply appear without a large supporting cast, all of which is now gone there. And this same story has been repeated over and over.

Except "they" is "we." We brought in inappropriate plants by the droves, without thinking about the consequences (it wasn't the plants that were innately bad but rather the thought processes that brought them here). We mostly didn't think about our innate need for natural open spaces, nor about the needs of pollinators or about the critical resources open spaces, especially wetlands, provide for us and other species. We didn't think about the extent to which available land and space could sustain a given number of people.

That the pioneers rode into a valley containing nothing but sagebrush (in fact, a very valuable plant) and essentially without trees and wet places is, at least in part, a myth. This desert already bloomed like a rose without our attempts to irrigate it. We know that early peoples lived here for thousands of years in sustainable numbers with a wealth of natural resources to sustain them in a unique area where the Great Basin meets the Wasatch. When provinces meet, life tends to flourish. Our valleys did not need to be decorated with non-native lilies and tulips; equally beautiful and better adapted plants were already here. Salt Lake County, for example, boasts one of the highest areas of vascular plant di-

Asclepias incarnata

*Verbena hastata*

versity per square mile in a richly diverse state, despite its now greatly impoverished condition.

Verdant meadows, some with springs or adjoining shallow streams that would occasionally overflow their banks, engineered in part by squadrons of beavers, as well as large creeks and rivers dotted the central Wasatch Front. In these places grew Western water birch, Fremont's Cottonwood, Narrowleaf Cottowood, Box Elder, River Hawthorn, Coyote Willow, and Golden Currant, with a rich cohort of other native shrubs, forbs, grasses, horsetails, sedges, rushes and mosses. We tend to disparage these natives and place them in categories such as "trash trees" while then planting awful, introduced species in their place, and paving over the rest.

We can all help to recognize and encourage the saving of our wet places by also recognizing that it isn't just xeric plants that should be used in our landscapes. We have wet and shady places too. There are appropriate types of locally native plants for every possible landscaping need. In a wet area, you need native plants that enjoy moisture for that elevation and locality. And there are many available to choose from, yet they are routinely ignored in favor of a store bought exotic. This prejudice against our very own natural heritage needs to stop.

New and existing homes near the Great Salt Lake are potentially perfect candidates for the use of valley elevation water-loving species in appropriate micro-environments. Ready-made soil already exists on-site. These species exist naturally nearby. Local, natural sources of seed should be utilized. Some plants may even spread on their own into newly available habitats made available by homeowners. Open spaces in these neighborhoods should include natural open space where these species can continue to survive.

*Helianthus nuttallii*

A bonus to using our locally occurring native species in landscapes is that they provide color and interesting growth throughout the year. At times when manicured monocultures of store bought plantings look dull and drab, natives shine. And wetland species while also blooming in the spring, really tend to get going in the summer and well into the fall. Nothing will surpass or outlast them especially if a wide diversity of species are used and care is taken in matching them to appropriate places.

*Eupatorium maculatum* var. *bruneri*

The few places left that contain tiny fragments of these precious wet ones require our full attention. No more can be lost. Citizens must step forward and do what they can to ensure that these areas receive priority. Recognition of important wet areas should not get hung up on overly restrictive definitions of what wetlands are: if native wetlands or riparian plants grow there, that is all that matters. Wet meadows are, in particular, lacking in protected park lands. Every city should have at least one designated natural open space park or equivalent protected area, the primary feature of which represents a wet meadows or patch of wetlands.

*Tony Frates, Utah Native Plants Society*

*For a list of native Utah wetland plants, visit www.fogsl.org*

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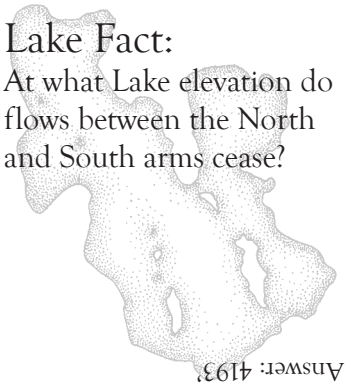

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*Who Me?* by Rob Dubuc