FRIENDS of *Great Salt Lake*

P.O. Box 2655, Salt Lake City, UT 84110-2655 801-583-5593
www.fogsl.org

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September Sunset on the Antelope Island Causeway by Dayle Record (oil on board) 2014

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, advocacy, and the arts.

Executive Director's Message

Finding "Here" at Great Salt Lake - No Matter Where you Go - There You Are

"God, how I long to go out West again someday - to drive some blue highway in Nevada or Utah until there's absolutely nothing around me, then stop the car, in the middle of the road, maybe, and get out and just stand there, where I can see the horizon in every direction, and smell the air, and feel the sun and listen to the silence of the desert. I have this idea that if I could do this, time might hold still for a second, and I would know, for just a moment, what it feels like to be here."
-Tim Kreider, author of "We Learning Nothing" a collection of essays and cartoons.

Totally impulsive, on a sunny and freshly rain-washed morning, two-weeks into the annual Utah waterfowl hunt, my spouse and I went birding at Farmington Bay. Camouflage, hunters, boats, pick-ups, dogs, and decoys provided ample on the ground evidence that the hunt was in progress. It's one of the many seasonal dances at the Lake that simply comes with the territory. And yet, even with this buzz of enthusiasm and recreation, the Lake was still "ours". We spotted several species of grebes and ducks, American White Pelicans, Great Blue Herons, Snowy Egrets, Marsh Wrens, Canada Geese, Northern Harriers, Killdeer, Red-winged and Yellow-headed Blackbirds, California Gulls, Dowitchers, and a solitary muskrat. Not bad for being impulsive.

Farmington Bay Waterfowl Management Area is a popular and accessible birding, bicycling, and seasonal hunting area along the eastern shore of Great Salt Lake. Just take the Farmington/Glover Lane exit on I-15 in Davis County. It's one of eight Waterfowl Management Areas (WMA) located on and around the Lake that comprise nearly 90,000 acres of public conservation properties that belong to the people of Utah. You can drive or cycle around the dikes like we did, or visit the Great Salt Lake Nature Center – soon to become a state of the art visitor/education facility, and meander along the walking trail.

Managed by the Utah Division of Wildlife Resources (DWR), the function of these WMA's is to maximize habitat values for a range of waterfowl, shorebirds, songbirds and raptors during migration and nesting seasons. The Great Salt Lake, its wetlands, open water, shoreline, and island habitats is an important aquatic ecosystem; locally, in North America, and within the Western Hemisphere. "It's an international hub that connects migratory bird flyways of hundreds of thousands of shorebirds and their allies as they wing their way from one point of life to another." That's Don Paul, Chair of Utah Linking Communities. Linking Communities is a hemispheric partnership to protect range - wide migratory bird species and their habitats.

The Lake provides critical habitat for over 260 species of birds – many of which are globally significant in their numbers and rely on the Lake for resting, staging and nesting.

The Lake is also one of the most important waterfowl breeding areas remaining in the U.S. with an annual waterfowl use that exceeds 3 million birds that includes 35 species. That's about 30% of all waterfowl in the Pacific and Central Flyway. The Lake and these WMA's provide them and us with a unique refuge of solitude and engagement. And that's why we were here.

Waterfowling – a term I've learned in my work for the Lake – is a deep tradition in our Utah culture that has endured for over a century. Of course, native peoples who lived near the Lake before white men arrived took advantage of the seasonal bounties of waterbirds as well. Personal journals and archives from the 20 private duck clubs that are located along the fringes of the lakescape, not to mention the duck hunting airboaters, reveal a rich family tradition of hunting ducks, geese and swans at the Lake and nearby tributaries for generations. A tradition that's consistent with a cultural dynamic throughout the West that appeals to the love of nature and place.

Waterfowlers have an innate understanding about the dynamics of the Lake, and are among the strongest advocates for its protection. A study was conducted in 2011 by Duffield, J., C. Neber, and D. Patterson (Bioeconomics, Inc.). – "Utah Waterfowl Hunting: 2011 Hunter Survey, Hunter Attitudes and Economic Benefits. The study showed that the estimated economic impact in the Salt Lake City area of waterfowl - hunting related expenditures generates $97M and 1,600 full time jobs. Dollar values are an important part of the picture. But dollar values are only one part of the picture. Great Salt Lake is who we are, where we are, and how we are in this place that is a part of all of us. And it matters. We're such lucky ducks.

Not to be overlooked in this notable mix of wetland management areas that serve to fulfill our stewardship responsibility for this wildlife endowment of the Lake is the Bear River Migratory Bird Refuge. Established in 1928,

the refuge is approximately 74,000 acres and is owned and managed by the U.S. Fish and Wildlife Service. Located off the Forest Street exit on I-15 in Brigham City, the refuge is a key contributor to this bird rich picture. It's connected to Bear River Bay - designated an Important Bird Area by National Audubon.

"Of all the important aquatic bird environments on the Lake, the Bear River Bay is the sweetest spot for diversity and numbers of birds during long-term average Lake elevation periods." Don Paul.

Long-term average Lake elevation periods is worth repeating because today, the current elevation of Great Salt Lake is 4,192.5' - only 1.5' above the 1963 record low of 4,191'. Water in the bays plays a huge part in the number of waterfowl that come through and stay at the Lake. According to Blair Stringham, Utah Waterfowl Coordinator with DWR, it's not uncommon to see around 500,000 birds in the WMA's in September. When the three bays (Bear River, Farmington and Gilbert Bay) have good water, it's not unusual to have hundreds of thousands there too. Right now, in Bear River Bay there are probably 300,000 Green-winged Teal near Promontory. But when compared to the hunt last year at this time, the bird numbers are down. The low Lake level is likely a key factor.

At the Great Salt Lake Technical Team meeting last August, a presentation about the proposed Bear River Water Development Project was made by the Utah Division of Water Resources (DWRe) and consultants from Bowen Collins & Associates. The genesis of this project comes from the 1958 Bear River Compact amended in 1980 that allocates water from the Bear among Utah, Idaho and Wyoming. Through the Bear River Development Act 1991 –DWRe is authorized to develop the surface waters of the Bear and its tributaries to the tune of 220,000 acre feet annually to address the projected water needs of Utah's growing population by 2060.

The Bear River is the source of 60% of Great Salt Lake's surface water inflows. A water development proposal of this magnitude would certainly impact the Lake and the range of ecosystem services it provides. We already know about the wildlife and the critical habitat needs that would be at stake but so would mineral extraction, the brine shrimp industry, and recreation and tourism that themselves contribute $1.3B annually, and 7,700 full time jobs to Utah's economy.

The Bear River Water Development Project is extremely controversial for a variety of reasons. The rationale for building it is weak. It would be a huge burden on Utah taxpayers to construct. Impacts to the Lake's ecosystem services aren't even considered. And the modeling and projected water needs to justify the proposal are based on a 1990's water picture that doesn't reflect our changing climate or drought cycles.

A Legislative Audit to determine the reliability of DWRe's data and assess the accuracy of its projections of water demand and supply was released in May 2015. The audit lists a passel of things that need to be addressed to provide a more accurate picture of Utah's water supply and needs. It also indicates that any shortfall in the water supply by 2060 could be filled from current sources with agricultural water conversions and more efficient water use.

The audit is available at: www.fogsl.org/advocacy

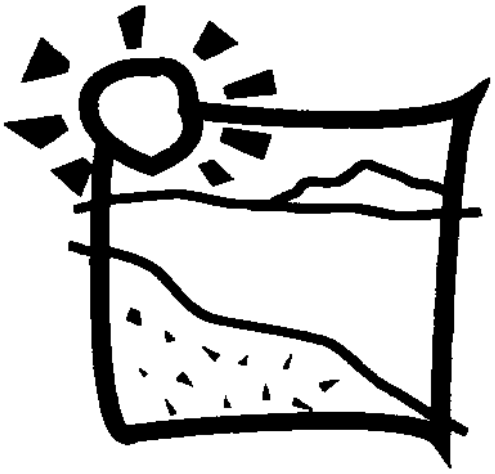
So here we are at the Lake watching some hunters unloading their boat after being out on the water since before dawn. I asked them how they did. Along with a tired smile, one of the hunters said, "It was good. We got two cinnamon teals and a chance to catch up."

Savor it. Recognize it. Talk about it. Protect it.

In saline,

Lynn

What you can do: Visit www.fogsl.org and visit Great Salt Lake



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, advocacy, and the arts. 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.

Janessa Edwards, hired in 2014 as Education & Outreach Director, is working to strenghten the Lakeside Learning Field Trip Program and FRIENDS community outreach.

In 2014, FRIENDS of Great Salt Lake awarded the First Annual Alfred Lambourne Prize to Dr. Marden Pond, Sound Artist, for his musical composition entitled "Sanctuary."

In 2015, FRIENDS awarded The 2nd Annual Alfred Lambourne Prize to Max Rosenzweig. Also this year, Chris Mansfield was named the Doyle W. Stephens Scholarship Recipient. Kimmy Ertle was hired in 2015 as Membership Coordinator.

On the Cover

September Sunset on the Antelope Causeway by Dayle Record (oil on board) 2014
This work is a painting of a photograph taken in 2011. It was submitted for the 1st Annual Alfred Lambourne Prize in 2014

"Racing across the Lake to lift the evening storm, the wind makes furrows, and the shore pushes back against them. Sunset clouds reflect the last light and play out in reflection across the Lake, for many, many miles in a mixture of blue, salmon, and green tints. The north end of the Wasatch Range drops over the edge of the view and the Promontories are getting some rain. Looking across the Lake from any shore is solace and a reminder of just how Earth meets eternity."

Dayle Record can be reached at daylerecord@gmail.com

Creative Expression Inspired by Our Inland Sea

Newfoundland Mountains, by Patrice Showers Corneli
Submitted for the 2015 Second Annual Alfred Lambourne Prize

New Great Salt Lake Coordinator is Ready, Willing and Able to Do the Job

I started in August 2015 with the Utah Division of Water Quality as the Great Salt Lake Coordinator. As the new coordinator, I am excited to work on such an interesting and important ecosystem, and I look forward to working with a diverse set of stakeholders.

Although I grew up in southwest Michigan, a lot of my best memories are from family camping and fishing trips through the northern part of the state. These trips inspired a passion for ecology and the environment and lead me to pursue a degree in environmental science at Northern Michigan University. In addition to working on classes during my time at NMU, I also had the opportunity to do seasonal work which included waterfowl and marshbird monitoring, wetland plant surveys, and environmental education.

I completed my B.S. in Environmental Science in the spring of 2010 and moved to Logan, Utah to pursue a Master's in the Watershed Sciences Department at Utah State University. My move to USU was a chance to work with and learn from leading experts in aquatic ecology and assessment. For my thesis work, I built a set of stream biological assessment tools for the state of Nevada and developed a series of statistical models to link those assessments to water quality and land use data and identify likely causes of impairment.

I finished my M.S. in Aquatic Ecology in the spring of 2012 and was hired on to continue my work as a research associate. In this position, I continued to advance the science of aquatic ecosystem assessment, developing several state-of-the-art stream, lake, and wetland assessment tools for state and federal agencies. As an associate, I also contributed to several research projects seeking to expand our understanding of physical and biological processes in aquatic ecosystems. In particular, I was a member of an interdisciplinary team of ecologists, hydrologists, and climatologists that performed a nation-wide assessment of the potential effects of climate change on the physical, chemical, and biological condition of aquatic ecosystems.

When I'm not working, I can often be found on a trail or a trout stream. I enjoy biking, camping, and hiking, but I am especially an avid fly tyer and fisher. I'm also a big fan of music and soccer, and I'm already enjoying the ready access to both in Salt Lake City.

The chance to work on the Great Salt Lake is an exciting opportunity for me. The Lake represents a true frontier in aquatic ecology which presents not only a great challenge, but also an excellent opportunity to learn and hopefully have a positive impact on a unique and valuable ecosystem.

One of my first priorities for work on the Lake is in Farmington Bay. Currently, UDWQ is planning to establish a working group, write a synthesis paper, and organize a symposium to aggregate current research, outline important research questions, and identify a path forward to address concerns about eutrophication in Farmington Bay.

I look forward to working with FRIENDS of Great Salt Lake and other stakeholders to tackle these challenges and work towards a healthy and sustainable Great Salt Lake.

Jake Vander Laan
jvander@utah.gov

Utah's Sanctuary: Great Salt Lake

There was an era, beginning in the late 1800s and continuing well into the 20th century, when many people traveling through the American West sought to make Great Sal tLake a destination. This was due to the curious nature of the Lake and the fact that locals had created a recreational haven on its shores; places to have fun and relax from the cares of the world.

The Great Salt Lake was something people wanted to see, experience, and yes-even taste. Maybe they had learned about the ancient giant inland sea or the vast salt desert in a grade school history, or in a college geography or geology class. The great western explorers such as Jim Bridger, John C. Fremont, and Kit Carson all spent time around the lake and their exploits were recorded in the textbooks and dime novels of the day. A visitor's interest was possibly piqued because the salinity of the Lake's water (up to 8 times that of the ocean), allowed a swimmer to float, and not sink. Whether a scientific question, or a personal curiosity, they could experience the increased buoyancy for themselves. Automobile enthusiasts were drawn to the salt flats; where they could witness cars achieve speeds once thought only possible by airplanes. Even the railroad lines of the day produced brochures about this 'salt sea' to be read by their passengers as they crossed the trestle which traversed the very lake itself. Whatever the reason, visitors and locals once flocked to Great Salt Lake's beaches by the tens of thousands to actually touch and experience one of the world's great natural wonders.

However, those days are gone.

The dozen or so recreation resorts that once dotted the shores of Great Salt Lake are no more. Sounds of laughter, screams from the carnival midways, and music from the giant dance halls are silent, and swimming is an insignificant fraction of what it once was. School lessons hardly touch upon the area's history, while science and geography books give only a superficial mention of the lake's unique properties. Unfortunately, knowledge of Great Salt Lake has been all but lost to the present American public, and locally the Lake barely registers a blip on most people's radar. But like so much in today's world, those willing to invest a little time and energy, will find a treasure trove of wonders as they visit and become acquainted with Great Salt Lake.

Learning about the science and history of the Lake can help unify us in taking care of this irreplaceable natural resource. Thoughtful consideration for the wildlife and delicate geological needs of this region is an effort worth undertaking and perpetuating. Over the years, a number of sensitive artists (including poets, painters, composers, filmmakers, photographers, earth-sculptors, and others) have been profoundly moved by the stark beauty of the Lake's environs and have sought to enhance that splendor. These perceptive creators have shared a vision in remarkable and deeply moving ways – ways that engage and encourage a further interest in and reverence for the incomparable beauty that is Great Salt Lake.

Fortunately, there are many local organizations dedicated to helping Utah's students, both young and old, appreciate the wonderful asset Great Salt Lake is to people not only of the Beehive State, but also of the world. KBYU Eleven is adding to this awareness by producing an hour-long documentary, Utah's Sanctuary: Great Salt Lake, airing December 7, 2015. The program explores the history, recreation, industry, nature, and art associated with this unique and intriguing body of water.

Rob Sibley, Producer/ Director BYU Broadcasting

Marden Pond, recipient of the 2014 Alfred Lambourne Prize

Saltair Circle 1910, photo courtesy of KBYU

Close to the Edge - KUCC South Zone

When you think of Kennecott, you probably think of copper. You may even think of real estate due to Daybreak's big footprint in the south part of our valley. Do you ever think of water treatment when Kennecott comes to mind? Probably not!

For over ten years, Kennecott has pumped at least 6 million gallons per day (6 MGD) of contaminated groundwater from several hundred feet beneath their property. Since 2006, they have treated half of it (3 MGD) to the highest level of water quality, and delivered it, for free, to Jordan Valley Water Conservancy District (JVWCD). They dispose of the other half. Any idea why they are treating it, or how they are disposing of the other half?

Kennecott doesn't do it as a business venture, or simply out of the goodness of their hearts, they're just obeying orders. They caused the contamination by allowing decades of seepage from surface ponds that held leach water. Then back in the late 1990's the State of Utah and the EPA mandated Kennecott clean up the contaminated water and give it back to the citizens of Utah.

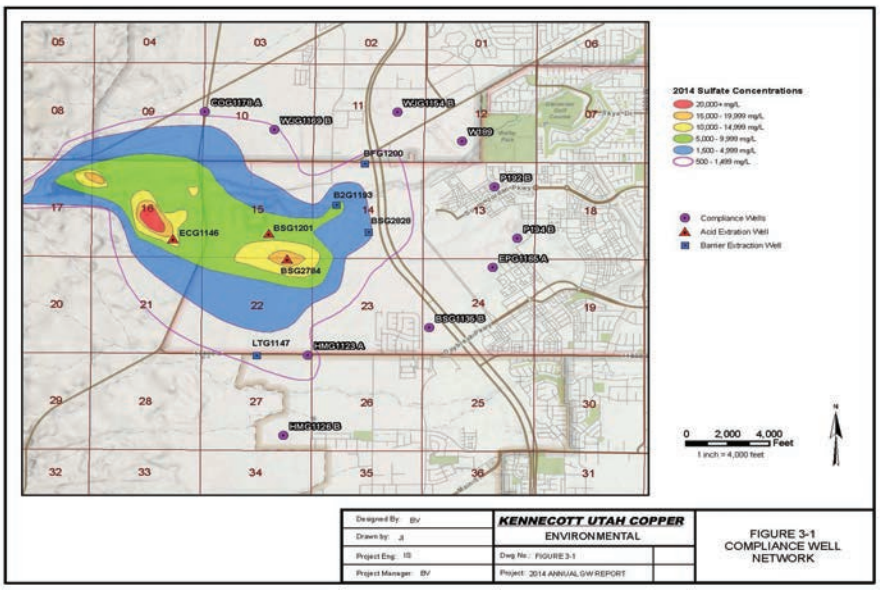
Kennecott accomplishes this cleanup in three steps: pumping the water, treating it and disposing of the byproducts.

The first two steps are expensive. It costs alot to drill wells, pump water around the clock, and treat it with reverse osmosis.

It's also inefficient. For every ten gallons pumped and treated, two to three must be discarded as concentrated leftover brine, a wasted byproduct. The third step is not expensive, as Kennecott can dispose of the brine (and of the untreated well water that they also pump) in their own tailings impoundment.

Even though the 3 MGD Kennecott treats is just a drop in the bucket compared to the 180 MGD of drinking water that JVWCD processes every day, it amounts to enough water to satisfy the daily needs of about 15,000 people. With water becoming more precious here due to population growth, every little bit helps.

If you are one of the 600,000 residents along the Wasatch Front who get water from JVWCD, you may be interested to know that this treated water from Kennecott goes right into your drinking water pipes. Take heart. It is a small percentage of what you drink, and is highly treated, closely monitored, and regulated under a State drinking water permit. What you need to keep your eye on is the disposal of the byproducts of this project as a whole.



Take a few minutes to look at this Figure from Kennecott's 2014 South Facilities Remedial Progress Report and note the contaminated groundwater plume surrounded by the blue contour line. This is the plume from which Kennecott is pumping groundwater. It is about two miles wide by two miles long. It moves very slowly eastward, along with groundwater flow, in the direction of the Jordan River. Due to its density, it also sinks deeper into the aquifer. The plume's status is monitored with a veritable pincushion of very deep water wells. If you tried to dig a hole to reach the contamination, you'd have to dig 400 feet to reach groundwater (which coincides with the upper level of contamination) then another 300 feet or more to reach the lower level of contamination. That gives you an idea how deep these wells are! Compared to the other Kennecott plume in the Salt Lake Valley, this one is the worst.

The three red triangles on the Figure are wells that pump from the worst, most acidic, part of the plume. This acidic water is contaminated with dissolved metals and is not a good candidate for drinking water treatment. They pump from this area to clean up the worst of the plume. This water is disposed of in the tailings line – more about that later.

The four blue squares are wells that pump from the plume's outer edge, which is far less contaminated. These wells are meant to create a barrier, or establish a plume boundary, to keep the plume from wandering off property. It is this barrier-well water that is treated for drinking water. All but one of the acidic and barrier wells are pumped around the clock.

Finally, there are compliance wells, shown as purple circles, which are not pumped but instead routinely sampled to watch for signs of approaching contamination. Not shown are the hundreds of wells whose water levels are monitored or sampled for contamination and are critical to understanding how this plume responds to pumping.

You may wonder, "How does this impact Great Salt Lake?" Well, for one, the byproducts are stored adjacent to the Lake in Kennecott's North Impoundment. The acidic water and leftover brine travel ten miles down the tailings pipeline to the Impoundment, along with all of Kennecott's spent ore. Luckily for Kennecott, the properties of the ore, "dressed" with lime upstream to improve mineral extraction, are usually suitable to neutralize the acidic water and precipitate the dissolved metals. If the ore is not suitable, more lime is added. Some stakeholders debate whether this tailings pipeline strategy should be called "treatment". Nevertheless, it is the EPA-approved way to stabilize these byproducts. Once the ore and water reach the Impoundment, the tailings (and precipitated metals) settle to the bottom. The water makes a pond on top which is pumped by Kennecott for reuse in their industrial process, and the remainder is intermittently discharged to Great Salt Lake.

One of the main threats to the Lake is the potential remobilization of the metals in the Impoundment. At present, they are immobile in their precipitated (solid) form and confined by the Impoundment. However, certain events could cause them to be remobilized, i.e. dissolved, and released into the environment. Two possible events are described below.

First, if the pH in the Impoundment becomes more acidic, the metals could redissolve. To prevent this, Kennecott monitors the tailings chemistry in the pipeline regularly, both upstream and downstream of the addition of well water, as well as the pH in the Impoundment. They also

have to meet State-regulated UPDES discharge permits to Great Salt Lake (if metals remobilize, they will appear in the discharge). Certain events have the potential to impact pH. For example, when mining was interrupted by the 2013 landslide, there was no ore to neutralize the acidic water. The pumps at the acid wells had to be turned off until piping was completed for a contingency lime-feed system so that lime could be added at the proper location. From this example you can see the system requires close attention. Kennecott will have to carefully monitor the Impoundment for a very long time. When mining eventually ceases and there is no more ore in the tailings line, lime dosing is the EPA-approved post-mine-closure plan.

Second, if an earthquake (always a threat along the Wasatch Front) caused the Impoundment to fail, the precipitated metals could be dispersed, become susceptible to environmental pH changes, and remobilize. While the contaminants' proximity to the Lake is a concern, the North Impoundment does meet State of Utah safety requirements for stability. To improve this situation, could the byproducts be disposed of elsewhere? From a practical standpoint, that answer is no, not without major changes to the process.

One of the benefits to the Lake is that this project raised awareness of the Lake on a state, national, and worldwide level. One component of this project required JVWCD to pump and treat water from their wells in tandem with Kennecott's. JVWCD asked for a State permit to discharge their concentrated brine to the Jordan River. This spawned a detailed five-year $2.5M study of Lake ecology conducted by international toxicology and wildlife experts and prominent local stakeholders. The outcome was a significant achievement in the history of Great Salt Lake: the first-ever numeric water quality standard on Great Salt Lake, for selenium. (And, ironically, a $25M 21-mile almost-completed pipeline so that JVWCD can discharge their brine to the Great Salt Lake instead of the Jordan River.)

To date, most measures indicate the treatment process has been effective. Without it, the acidic water, though inaccessible in the short term, would have moved slowly eastward toward the Jordan River. Dissolved metals would have threatened susceptible biota in their path. 15,000 residents would be relying on another water source. With it, Kennecott is complying, producing treated drinking water as required, and over the last decade, the plume size has reduced. Literally tons of metals contamination have been removed.

Many years of treatment lie ahead. Kennecott will continue to provide a limited amount of drinking water. But their metals, immobilized in the Impoundment, remain perched on the edge of the Lake. The long term success of the project remains to be seen.

Joy Emory, an environmental engineer, has served on the Kennecott South Zone Technical Review Committee on behalf of Friends of Great Salt Lake since 2002.

A Sailor's Smartwatch by Charles Uibel

An Exchange Between Iran's Lake Urmia and GSL

A few scientists, managers, and advocates involved with Great Salt Lake (GSL) hosted and interacted with a group of about 15 Iranian scientists in late June 2015. The group was here on behalf of Iran's Lake Urmia and included representatives from the Iranian Department of Environment; the Urmia Lake Restoration Program; the United Nations Educational, Scientific and Cultural Organization (UNESCO); the Geological Survey of Iran; and other organizations. Lake Urmia is a terminal saline lake with many similar characteristics to GSL including size, but due in large part to increasing upstream water depletions and recent decreased precipitation the lake is facing very low water levels and the possibility of drying up. A primary goal of the Iranian scientists' trip was to learn about other lake systems and perhaps glean ideas to help them address challenges presented by their desiccating lake. On their way to GSL, the Urmia group visited other lakes facing similar situations including Owens Lake, the Salton Sea, and Mono Lake in California.

The Urmia group was exposed to a comprehensive overview of GSL during a one-day conference at the Utah Department of Natural Resources that included information on GSL geography, hydrology, salinity cycle, water quality, management, advocacy, and industry. GSL was well represented by participants from Utah State University (USU); the Utah Division of Water Quality; the Utah Division of Water Resources; the Utah Division of Forestry, Fire and State Lands; FRIENDS of Great Salt Lake; the U.S. Geological Survey; and the Utah Geological Survey. Following the conference, Professor Wayne Wurtsbaugh from USU led the group on a field trip to Antelope Island so they could experience the Lake firsthand.

Ali Chavoshian, a representative of UNESCO and the Iranian Regional Centre on Urban Water Management, described Lake Urmia's current conditions to the GSL representatives. Lake Urmia has lost 80% of its volume from previous levels, and withdrawals upstream, primarily for agriculture, are currently consuming 70% of the lake's renewable water resource, which is well above the 20 to 40% that is considered to be sustainable for the lake system. Lake Urmia has also lost most of its ecological function, which previously included brine shrimp and migratory bird habitat, due to high salinity caused by low lake levels. An intriguing response to the degradation of Lake Urmia's system has been prepared by the Urmia Lake Restoration Program, which operates under Iran's Ministry of Energy, by establishing a target "ecological level," or a lake level at which ecological function could be restored and maintained. In this case, the ecological level represents a lake level at which brine shrimp populations are expected to return. Currently, the lake level is about 3.5 meters (11.5 feet) below the defined ecological level. The restoration program has recommended a variety of actions to reach the ecological level including better management of upstream agricultural withdrawals and changes in dam management. They have also produced a timetable and series of projections that suggest a target restoration date to the ecological level by 2023.

Hopefully the brief exchange of information and ideas from our June meeting and ongoing interactions will prove valuable for the Urmia Group as well as people involved with GSL as both lake systems will likely face similar challenges over time. Within the next decade or so, the Iranians' strategies to restore Urmia, such as the establishment of a target lake level, may provide insight for the various entities responsible for GSL as they seek to preserve the variety of beneficial uses--ecological, industrial, and recreational--that the lake provides.

Andrew Rupke
Industrial Minerals Geologist,P.G.
Utah Geological Survey/Utah Department of
Natural Resources

Great Salt Lake/Rozel Point by Jeff Clay

Great Salt Lake Education

You Need the Dirt for Seeds to Grow

It's been all about sunscreen, sandals, and our shade canopy since the end of our Spring Lakeside Learning Field Trip season. FRIENDS of Great Salt Lake's education staff has been hard at work attending outreach events and running our Great Salt Lake Discoveries Summer Camp with our partner the Natural History Museum of Utah. Every camp has a story. This year, we conducted two successful week-long exploratory camps – one with all boys, and the other with all girls. After having time to reflect on both experiences, one camp's story began to take on a whole new meaning.

As we waited for a thunderstorm to pass we stood looking out at Great Salt Lake, pointing out various landmarks to twelve anxious campers from the museum window. Over the course of the week they would discover Great Salt Lake from various locations and learn about its unique, briny ecosystem. As the kids packed up their lunches and piled into the cars, we were off to explore the wetlands of Farmington Bay – camp had officially begun.

After a nature walk, we put the binoculars away and the kids were off into the water only to be seen by the swift movement of the bulrushes and an occasional glimpse of a net waving in the air. There was no hesitation with getting muddy or any scared, high-pitched screams from this group of girls because they were watershed warriors.

We laughed as we passed out hand wipes to the young warriors, who were huddled under the shade canopy for lunch with mud stained legs and the occasional wet shorts from "falling" in. It is unfortunate how often girls who are active or like to play outdoors are viewed in an off-putting way by their peers.

Photo courtesy of Holly Newell

This can influence a girl's confidence and her interests in science, the outdoors, and physical activity in general.
Camp is an experience. We want to discover the briny waters of Great Salt Lake using all of our senses.
That means getting dirty! Our Lake provides the perfect setting for girls to explore and make observations without the peer pressure, which allows them to learn with more freedom and begin to envision themselves as scientists.

As we walked back to the cars eager for the ice cream cone good behavior had won them, a camper asked me, "Do you really get to do this every day?" and with a smile I replied, "Yeah, it's my job to explore and teach kids like you every day. Pretty cool, right?" Bounding around me she shouted "I want to do that! I want to do that!."

It was an extraordinary moment, a seed being planted. One day this girl may become a renowned scientist in a field where, despite improvements, women are still under-represented. Many studies have shown that young women who have models of other women thriving in the scientific field are inspired to pursue a similar career.

Twenty years from now when she is accepting her Ph. D in wetland ecology, exploring the wetlands at Farmington Bay may not stand out when she shares her story of how she became interested in science to begin with. We're are okay with that. Planting a seed is setting something in motion. It takes a seed time to grow.

As another summer season comes to an end, we hope that with continued successful programming, supportive partnerships, and a passionate staff we can continue to offer these types of camps to inspire more girls to become interested in science and preserving our precious Great Salt Lake.

For more information about our Great Salt Lake Discoveries summer camps, contact pelician@fogsl.org.

~Holly Newell, FRIENDS of Great Salt Lake Education Coordinator

Great Salt Lake At A Glance

Courtesy USGS

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.

IRAN'S LAKE URMIA IN CRISIS: CAUSES AND LESSON LEARNED

Lake Urmia and its Surprising Similarity to Great Salt Lake

Lake Urmia is one of the largest salt lakes in the world and it is located in a closed basin in north-west Iran. The Urmia is an Assyrian name meaning Puddle of Water. The basin area is 20,000 sq., miles (51,870 km^2) and at its full size, it is the largest lake in the Middle East and the sixth largest saltwater lake on earth with a surface area of about 2,000 sq. mi (5,200 km^2). The depth of the lake used to reach 52 feet (16 m) with an average depth of 18 feet (5.4 m). Due to its unique natural and ecological characteristics, Lake Urmia is a protected area as a UNESCO Biosphere Reserve and a "Ramsar Convention" site.[1]

Lake Urmia is very similar to Great Salt Lake in many physical and environmental characteristics. Lake Urmia is located in the elevation of 4,183 feet above sea level that is comparable with the Great Salt Lake at the elevation of 4,200 ft. Interestingly surface area and even the shape of both lakes are very similar. Both lakes have been divided by causeways: A railway in the Great Salt Lake and a highway in Lake Urmia. As a consequence of causeway construction, there is lack of extensive water exchange between north and south parts of both lakes. Both lakes are famous for brine shrimp (*Artemia*) and brine flies (*Ephydra*) that support tremendous populations of migratory birds.

The Sad Story of the Lake Urmia and Root Causes

Lake Urmia's surface and water volume have been decreased dramatically over the last two decades. Satellite imagery has shown that by August 2015 the lake's surface area had been reduced to less than 20% of its original surface area (Figure 1).

The drying of Lake Urmia has caused severe socio-economic and environmental impacts in the region. The basin area is an important agricultural zone with a population of around 6.4 million people and an estimated of 76 million people live within a radius of 300 miles of the lake in five countries of Iran, Turkey, Iraq, Armenia and Azerbaijan. Those around the lake fear a situation similar to Aral Sea, which has dried up over the past several decades. Disappearance of the Aral Sea has been an environmental disaster affecting people throughout the region with windblown dust-storms. The population surrounding Lake Urmia is much denser than around the Aral Sea , putting more people at risk of impact. Like California's Owens Lake, the Lake Urmia bed is exposed to wind erosion causing enormous dust storms threating agricultural land and air pollution of the people in nearby cities.

The problem of Lake Urmia is not only a sharp decrease in water volume and surface area, but also increasing salinities that do not permit Artemia survival. The salinities of about 150 to 180 grams/liters are a normal condition for growing and regeneration of Artemia and salinities up to 300 grams/liter are considered the maximum for the survival of the native species of Artemia. However, the current salinity of the Lake Urmia is over 470 g/L.

A water level of 4180 feet is the minimum required to keep the salinity below 300 g/L. This level is called the "Ecological Water Level" for the Lake Urmia. However, in early August, 2015 the water level was only 4167 feet 14 feet below the Ecological Water Level. This means salinities have increased greatly and Artemia are nearly gone from the lake.

Today's miserable situation for Lake Urmia is result of long–neglecting lake conservation and ignorance of the effects of rapid development of agricultural, industrial and urban water use on the water flow to Lake Urmia. The drying of the lake has been the result of complex and varied natural and human factors such as increasing the amount of agricultural land, changing the crop patterns, and producing water–consuming products in the basin. Drought and climate change has reduced surface runoff throughout the basin. This, combined with a lack of effective protection of the basin's ecological and environmental resources has caused the disastrous desiccation of the lake.

Lessons Learned and the Restoration Program

The worsening condition of Lake Urmia resulted in the establishment of the "Lake Urmia Restoration Program (ULRP)" in March, 2014. This program has formally started and begun the following activities:

- Better analysis of the causes of the current Lake Urmia crisis and a prediction of future conditions of the lake;
- Attracting participation and cooperation of all responsible and relevant organizations and authorities to benefit from their professional expertise and view-

points;
- Benefiting from the know-how and participatory contributions of university professors, local and international professionals and researchers;
- Emphasizing the participation of local authorities in numerous and concordant activities to fulfill the ULRP objectives;
- Using informative mass media to create comprehensive "public interest", determination and participation in the restoration of Lake Urmia
- Compiling a roadmap for the restoration of Lake Urmia.

ULRP has shaped its restoration plan using two main strategies: (1) increasing inflow to the lake through improved water management in the agricultural sector, and; (2) minimizing water losses in the conveyance of water to the lake. Following these two strategies, the program has established a roadmap for Lake Urmia restoration with 25 countermeasures of which 18 items are ready to be implemented and seven items that need more study. According to the developed roadmap of the activities, the ecologic water level restoration of the lake will take between 8 to 10 years. The total required budget for the Lake Urmia restoration is estimated to be over five billion dollars (US).

Conclusion

In June 1995 the highest recorded water level of Lake Urmia was 4194 feet and it covered 2230 mi2 with a volume of 29.8 million acre-feet. The lake used to be ranked as the 6th largest inland saline lake in the world. In August 2015, the water level of the lake was only 4167 ft with an area of 430 square miles and a water volume of about 1.62 million acre-feet—5% of the maximum. This shows a dramatic degradation of the lake's environment due to a lack of proper conservation measures. The master plan for the restoration of the Lake Urmia was endorsed by the Iranian Government in March 2014. To succeed, the restoration program will need between 8 to 10 years and a budget of over five billion dollars. The level of the Great Salt Lake is also declining, so the lessons from Lake Urmia provide a sobering reminder to those in Utah of the costs of poor water management.

Ali Chavoshian 1&2
E-mail: chavoshian@gmail.com

(1) Regional Center on Urban Water Management (RCUWM) under the auspices of UNESCO
(2) Iran University of Science and Technology, School of Civil Engineering

1- UNEP. 2012. United Nations Environmental Program. The drying of Iran's Lake Urmia and its environmental consequences.

Lake Urmia courtesy of Ali Chavoshian

Public Shooting Grounds Waterfowl Management Area - Important to Resident and Migratory Species of Wildlife

Image courtesy of the Utah Division of Wildlife Resources

On June 27, 1925 land was set aside by Executive Order by the United States Government in what has been reported as the first public lands in the United States set aside for public hunting of waterfowl. The area was to be known as Public Shooting Grounds and managed by Utah State Department of Fish and Game, the stated purpose being waterfowl.

Public Shooting Grounds Waterfowl Management Area (PSGWMA) is located north of the Great Salt Lake and the Bear River Migratory Bird Refuge (BRMBR) in Box Elder County, Utah. This area is about 10 miles west of the town of Corrine. The Waterfowl Management Area (WMA) is managed by the Utah Division of Wildlife Resources (UDWR).

The primary purposes of PSGWMA have expanded to include: to preserve, restore, and enhance both aquatic and terrestrial habitat for wildlife; protect cultural resources; and provide for recreational opportunities that are compatible with the purpose of a wetland ecosystem.

Since most prime natural wetlands had already been acquired by private sources prior to 1925 for private hunting of waterfowl, the lands set aside and lands acquired to expand PSGWMA required extensive construction activities to create man-made wetlands. Dikes were constructed and water control structures were installed to create impoundments and marsh areas between the impoundments.

Following many years of water manipulation emergent marshes were established providing nesting cover and hiding cover. Pond weed developed in the impoundments providing a food resource for migrating waterfowl. Pond weed provided habitat for many invertebrates that provided food for waterfowl and many other water birds.

PSGWMA is important to resident and migratory species of wildlife, over 180 avian species, nine mammals, six fish, three mollusks, one crustacean, five snakes, two frogs, one toad, and one turtle have been identified. The diversity in wildlife species provide for great wildlife watching opportunities.

The wintering bald eagles utilize the area for foraging. This area is used by short-eared owl, burrowing owl and long-billed curlew during the reproduction period. Many species of waterfowl, water birds and terrestrial birds reproduce on the area. Many more feed and rest as they pass through in the spring and fall on their way north or south to summer and winter grounds.

This area has seasonal use allowed two days before the waterfowl season until it ends and during the light goose hunt. The rest of the time the gates are locked and public is excluded without authorization from the Division. You can contact the area Manager for more information.

The WMA is managed for hunting, wildlife production and to provide food resources for migratory birds. By reducing disturbance during the reproductive period wildlife can better maximize production, feed more efficiently and make a living with fewer stressors present. Managers try to manage maintenance activities, mosquito abatement activities and research activities to benefit wildlife on the WMA and reduce conflict with management objectives.

Image courtesy of the Utah Division of Wildlife Resources

There are great year round viewing opportunities nearby at Salt Creek Waterfowl Management Area further north and Bear River Migratory Bird Refuge to the south.

The water source for PSGWMA comes primarily from slightly saline springs to the north of the area and the water travels through Salt Creek WMA (SCWMA) then into PSGWMA. Other ephemeral summer sources are from return irrigation water. These water sources are critical for managing quality habitat. During periods when plenty of water is available the water leaves PSGWMA and travels through BRMBR and into the Great Salt Lake tying this WMA to the greater wetland ecosystem.

PSGWMA was not impacted during the flooding event of the 1980's when the Great Salt Lake reached a high point. Most adjacent wetlands to the Great Salt Lake where heavily impacted with high water and salt inundation. PSGWMA and SCWMA became an oasis for wetland birds during the years of flooding and subsequent years required reclaiming wetlands damaged by the rise of the Great Salt Lake.

The upland areas are mostly vegetated with greasewood and annual grasses. Soils are alkaline and precipitation is sparse at around 12 inches per year. Moderate livestock grazing is used as a tool to manage upland plant communities. Efforts are planned to renovate some of these upland areas to create a more diverse plant community. Due to the salty soil and salty water trees are nearly absent on the area.

Another interesting point is the historical transcontinental railroad grade to Promontory Point traverses PSGWMA. This has long been abandoned, but remnants of the railroad grade and trestles are still present.

To experience PSGWMA come visit during the fall and winter months when the area is open to the public. Enjoy.

Randy Berger, Wetland Manager, Utah Division of Wildlife Resources

Teals by Gary Crandall

FRIENDS of *Great Salt Lake*

How To Reach Us
FRIENDS of Great Salt Lake
150 South 600 East Suite 2B
Salt Lake City, UT 84102
801-583-5593
website: www.fogsl.org

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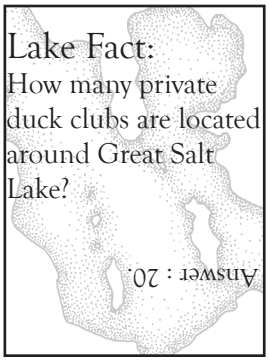
Lake Fact:
How many private duck clubs are located around Great Salt Lake?



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