FRIENDS of *Great Salt Lake*

150 S. 600 E. Suite 2B, Salt Lake City UT 84102 801-583-5593
www.fogsl.org

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Water Found - Little Creek
Charles Uibel

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

On the Water Front of Great Salt Lake - Taking the Initiative to Identify Ways to Provide Water for the Lake is the Right Thing to Do

"Great Salt Lake is an important resource and provides so many ecological, biological, economic and recreational opportunities that we cannot ignore it much longer. Climate change and our current hydrologic cycle may be our new normal. If so, we will all have to learn to get by with less water and the necessity to allocate some water to environmental preservation must finally be given equal dignity in the appropriation process as diversionary rights that deplete the water supply. We clearly have the ability to do this, and the legal tools to make it happen."

-Steve E. Clyde, Clyde Snow & Sessions
Water Rights for Great Salt Lake: Is it the Impossible Dream?

I'll begin my message with a big, briny thank you to Steve Clyde. Thank you, Steve for your initiative in opening a critical, timely and in some circles controversial door for engagement to talk about the legal tools that are available to provide water for Great Salt Lake. Clyde, an attorney with Clyde Snow & Sessions, is one of the state's most respected water attorneys. At the Utah Water Law Conference last October, I had the great pleasure of hearing his presentation: *Water Rights for Great Salt Lake: Is it the Impossible Dream?* (Read it at fogsl.org) To say the least, I thought Great Salt Lake's ship had finally come in. And although his emphasis was on the Lake, the takeaway in his talk was about the importance of our natural systems and how they should be given "equal dignity in the [water] appropriation process." Amen.

In fact, if I was stranded on a desert island – maybe in this case our very own Antelope Island – and only had 4 references with me to read, those references would be Clyde's white paper, Professor Robert Adler's Law Review article *Toward Comprehensive Watershed Restoration and Protection for Great Salt Lake, 1999, Impacts of Water Development on Great Salt Lake and the Wasatch Front, 2016*, a white paper by USU Professor Wayne Wurtsbaugh et al, and the *2013 Great Salt Lake Comprehensive Management Plan* compiled by the Division of Forestry, Fire and State Lands. The Division is in the Department of Natural Resources and has jurisdictional responsibility for managing the Lake in perpetuity as a public trust for the people of Utah.

I know what you're thinking right now – Geeze! That girl needs to get out more! But I do consider these 4 sources among the "Great Books" of Great Salt Lake.

For nearly 4 years now, I've also had the pleasure of working with Steve on the Governor's Water Strategy Advisory Team (Advisory Team). The purpose of the Advisory Team was to inform *Governor Herbert's 50-year State Water Plan* that will be designed to address projected population growth by 2060 and Utah's water needs. In fact, because of this valuable opportunity I've had the pleasure of working with a wide range of talent and perspectives on water in Utah. And I've learned a lot.

Forty one of us, all volunteers, were tasked by the Governor to "(1) solicit and evaluate potential water management strategies; (2) frame various water management options and implications of those options for public feedback; and (3) based on broad input develop a set of recommended strategies and ideas to be considered a part of the 50-yr water plan."
You can read more about this process in my Executive Director's Message (Winter 2017) and review the final *Recommended State Water Strategy, July 2017* at www.fogsl.org

The *Recommended State Water Strategy* is the result of respectful and robust debate among team members working in small groups to identify the issues and recommendations that support the eleven key policy questions in the strategy. We covered a lot of ground. The process was not without its fits and starts. And as you would expect there were the obvious sticking points particularly in the areas of conservation, climate change, and the need for new infrastructure like the proposed Lake Powell Pipeline and Bear River development projects. These issues required numerous draft revisions and negotiations among the team members that took us right up to the 11th hour.

Although Utah is the second most arid state in the nation we're not running out of water. We just need to be smarter about inventorying/accounting, pricing, and integrating the way we understand the dynamics and the use of the resource.

But Godzilla is back! This time in the form of climate change. Climate change will require supreme due diligence in our commitment to be responsible and timely in the way we implement strategies to mitigate its impacts.

Climate change is included in the strategy. The bottom line here is that although there is no perfect horse, we worked extremely hard to create a product that exhibited a shared long-term vision. A vision that, among a variety of things, includes Great Salt Lake and our environment, and ways to "modernize" the framework for Utah water law and policy to pay due regard to these important values.

On July 19th, the ink was finally dry on the document when we presented it to Governor Herbert at the State Capitol. He'll use it to prioritize his agenda moving forward. Even though our assignment was accomplished at that point, the strategy really marks a beginning for further engagement in our important work for Utah's water future and for the Lake. Ideally, it will be a working document that we'll use to continue to seek ways to create accountability. We're already talking about reconvening the Advisory Team annually for updates on how/or what we're doing based on the recommendations we worked so hard to forge. The collective water wisdom that went into this exercise provides us with a useful framework that helps us focus our collective work on these many different fronts with an eye on our Lake.

Speaking of collective work on the Great Salt Lake water front, at the July 12th Great Salt Lake Advisory Council meeting, a draft report *Water for Great Salt Lake, July 2017* was presented to council members. The report was commissioned by the GSL Advisory Council and compiled by SWCA Environmental Consultants. Its purpose is "to facilitate a discussion on how to reverse the long-term decline in Great Salt Lake water levels by considering potential strategies to maintain and/or increase the surface elevation (water levels) of Great Salt Lake. "

Currently, the draft consists of sixty-six strategies/tools submitted by groups and individuals in response to an invitation to more than 100 recipients that went out last May. The strategies are divided into categories that include: Coordination, Environmental, Legal, Operational, Policy and Structural. Many of the ideas in the draft are the same issues that were raised in the *Recommended State Water Strategy*. One more call will go out for any further contributions before the Advisory Council reviews the input and begins prioritizing the strategies at its September meeting. The game is afoot.

As you know, it's important to go wide and take a regional perspective and recognize the significance of Great Salt Lake in the context of other saline systems around the West. We need to be able to assess how those systems are doing because they also provide critical habitats for millions of migratory birds for resting, staging, and nesting during their journey. That's just what National Audubon Society's report *Water and Birds in the Arid West: Habitats in Decline, July 2017* does. This report is another important tool that helps inform our understanding about how water – or the lack of it due to upstream diversions and climate change ~ affects ecosystem health.

With the additional insights provided by the Great Salt Lake Level Matrix in the *2013 Great Salt Lake Comprehensive Management Plan* that visually describes how different Lake elevations influence habitats and ecosystem services that contribute $1.3B to Utah's economy. And the recently available *Integrated Water Resource Management Model* developed by CH2M for the state to help inform resource management decisions for Great Salt Lake, the time is ripe to move forward on the water front.

As Steve Clyde proposed in his presentation at the Utah Water Law Conference, " We clearly have the ability to do this, and the legal tools to make it happen."

In the words of the late economist, Rudiger Dornbusch "Things take longer to happen than you think they will, and then they happen faster than you thought they could."

So let's make it happen. We're ready. How about you?

In saline and summer,

Lynn

Black Rock Summer 2015 Kirk Henrichsen.
Submitted for the 2015 Alfred Lambourne Prize
See more - kirkhenrichsen2015.fineartstudioonline.com

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 Advisory Board consisting of professionals in the scientific, academic, planning, legal, arts, and education 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 was established in 2002 and is given at each GSL Issues Forum. It acknowledges a citizen, business or organization working to promote Great Salt Lake awareness in the community.

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

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 established the Annual Alfred Lambourne Prize to celebrate creative expressions inspired by the Lake.

In 2016 our Lakeside Learning Field Trip Program was recognized as the Environmental Education Program of the Year by the Utah Society for Environmental Education.

In 2016 FRIENDS hired Holly Simonsen as our new Membership Coordinator.

Girl, the Spiral Jetty and the Great Salt Lake by Susan Kirby, submitted for the 2015 Alfred Lambourne Prize

On the Cover

Water Found - Little Creek by Charles Uibel

This September picture looks east from the Salt Flats near Floating Island, which is east of Wendover. A temporary ribbon of water interrupts miles of mud and sand.
A road built up requires a trench to be dug.
Two lines in the sand, created for hurried lives. Yet the interval required for repair cannot be measured in human lifetimes.
greatsaltlake.photography

Creative Expression Inspired by Our Inland Sea

Rebecca Pyle
Black Rock, Surrounded by Chartreuse
Oil on canvas
20 x 24
Submitted for the 2014 Alfred Lambourne Prixe

The Little Bird That Could Derail a Train

How Research, Management and Conservation Can Drive Good Decisions

Eared Grebe courtesy GSL Ecosystem Program

After a fairly lengthy process, we finally connected with our old friend. This old friend was really down but by no means blue. In fact, instead of being blue, this old friend is usually different shades of pink. I am talking about the North Arm of Great Salt Lake (GSL) of course. This past December, the much anticipated railroad causeway bridge was opened and the North Arm of the lake allowed to once again mix with the South Arm.

Anyone who is familiar with the lake has surely seen the satellite photos highlighting its two-tone color. This color difference is due to the railroad causeway that bisects the lake, essentially cutting it in two. Since most of the fresh water that enters the lake does so by the 3 major river drainages that flow into the South Arm, it has created two distinct ecological units, which differ primarily in salinity. The South Arm typically varies from 12 to 17 percent salt and the North Arm remains at saturation or 27 percent salt. The failure and subsequent closure of the two culverts in the causeway had essentially cut off the flow between these two arms of the lake. To reconnect the two arms, the railroad planned to construct a new bridge. That impressive effort neared completion by the end of last summer.

The Great Salt Lake Ecosystem Program (GSLEP) is a section within the Utah Division of Wildlife Resources whose purpose is to manage and conserve the avian and aquatic communities of Great Salt Lake through monitoring and research. GSLEP learned in August that the bridge was scheduled to open in September. This news was particularly concerning to us at the time for a couple of reasons. Our chief researcher, Dr. Gary Belovsky, was worried that an abrupt change in salinity as North Arm water mixed with the South Arm would impact the brine shrimp population. His research showed that juvenile brine shrimp are extremely susceptible to changes in salinity. A rapid change in South Arm salinity had the potential to not only risk the current brine shrimp population but also the eared grebe population as well.

Eared grebes (affectionately known as "Butter Tubs") spend the winter at GSL in very large numbers. In fact, estimates have exceeded five million in recent years. This is over half of the entire continent's eared grebe population. They will typically arrive at GSL from August into October and feed exclusively on the brine shrimp. A PhD student from Utah State University had found that one eared grebe would consume approximately 30,000 shrimp per day while they are at GSL. Five million birds consuming 30,000 shrimp per day is . . . well, it's a lot.

The biggest confounding factor with these birds is

that they molt when they come to GSL and become flightless. They are not the most agile flyers in the first place, with a short wingspan and a chubby body. They are a little like flying butter tubs. They will always fly at night since it is cooler and they are not able to evade raptors during the day. They have been known to mistakenly land in wet parking lots during storms and become stranded since they require a running start to get airborne. Grebes can't run on a hard surface due to how far their feet are set back on their bodies. So if eared grebes eat brine shrimp exclusively and that food source has diminished, what are these birds going to do? Unlike other birds at that time of year, they would be unable to relocate. Our concern was that the timing of the causeway breach could possibly cause a catastrophic die-off.

GSLEP has a Technical Advisory Group (TAG) that meets three times per year to discuss research as well as issues concerning GSL. Coincidentally, one of these meetings occurs in the latter part of August and this is when our group was able to discuss the impending breach. All members of the TAG were concerned that the timing of the breach posed a threat to the system during the current year. It was imperative to attempt to have it delayed if possible.

This is the part of the story where a concerted effort was made to save the "butter tubs." On the GSLEP boat there is a mantra that says Research*Managemen t*Conservation, which encapsulates our goal as a program. If I could add anything to that, it would be Cooperation. To delay the breach, a number of agencies and groups involved would need to "sign off" on such a move. Typically, when you get more than one person in a room, it's hard to get a consensus on somebody's shirt color let alone a major decision like this one. Not to mention, several agencies had to agree and not just individuals.

The Director of the Department of Natural Resources had the interests of two Divisions (Forestry, Fire and State Lands and Wildlife Resources) in the discussion, and everyone wanted to ensure a sound decision was made at the end of the day. After a couple of impromptu meetings, phone calls and letters, an acceptable solution was reached. Contributions and concessions were made my multiple groups in order to make things happen. The Division of Forestry, Fire and State Lands, Department of Environmental Quality, and U.S. Army Corps of Engineers coordinated the permitting and requests to make this change. The Great Salt Lake Brine Shrimp Cooperative agreed to pay certain remobilization costs caused by the delay. Compass Minerals agreed to the delay despite the risk to their entire operations from lack of water for their North Arm operations, the Union Pacific Railroad sacrificed time and equipment for a couple of months. The Division of Wildlife Resources provided data and information. And numerous people behind the scenes expended a lot of effort to accomplish a delay in opening the new breach until December.

During most years, brine shrimp begin to die in December, and the eared grebes begin to head south, having completed their molt. This year, there were no major die-offs and the grebe population was estimated at nearly 5 million. Brine shrimp prospered and provided these birds with the fuel they needed to continue their journey. The raw brine shrimp harvest weight was over 33 million pounds for the year. And from a wildlife and ecosystem perspective, the risk was negated and it was a success.

Yes, cooperation was the key to this endeavor. Can't we all just get along? Well, after this process was in the books, maybe we can. If those stubby little wings could hold a pen, I think there would have been close to 5 million "thank you" notes sent and signed by the "butter tubs."

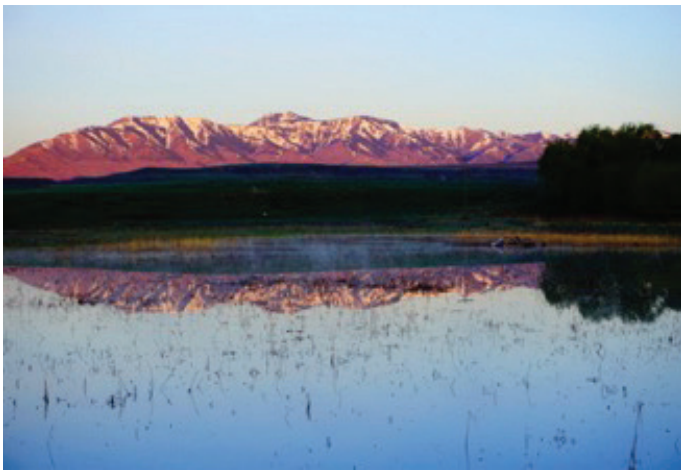
John Luft is Great Salt Lake Ecosystem Program Manager

Causeway Breach courtesy GSL Ecosystem Program

Conservation Easements; Protecting the Bear River in Northern Utah

It is 1862, and President Lincoln has just signed the Homestead Act into law, providing the opportunity for intrepid souls like you to head west, carve out a piece of ground, settle it, and eventually own it... IF you can survive five years. You gather seeds, livestock, and equipment, and head west to find that the Great Basin is a semi-arid-almost-desert, and a difficult place to live. With sparse water available, your priorities are clear: find water and settle nearby. What few rivers and streams the 'wild west' has to offer are quickly claimed.

The series of 19th century Homestead Acts were arguably the most important forces shaping the pattern of land ownership in the west, including Utah, and that partially explains why so much of our state's riparian habitat is in private ownership. As a result, protecting riverside areas important to wetlands and wildlife requires working with landowners and their varying interests and uses for the land they own.



Courtesy Bear River Land Conservancy

Enter the modern land trust, equipped with the tools to establish conservation easements in partnership with willing private landowners. Northern Utah has several land trust, including Utah Open Lands (statewide), Summit Land Conservancy (Summit County), Ogden Valley Land Trust (Weber and Ogden River watersheds), and the relatively new Bear River Land Conservancy (BRLC) which focuses along the route of the Bear River in Box Elder, Rich, and Cache counties. These private 501(c)(3) charitable organizations partner with federal and state agencies with similar goals (such as U.S. Fish & Wildlife Service's Bear River Watershed Conservation Area or Utah's Department of Natural Resources), but with a singular mission: save land for future generations. Nonprofit land trusts qualify for charitable contributions (from both individuals and foundations) as well as funding from state and federal programs. With flexibility and local leadership, land trusts are uniquely suited to protect land in the communities we serve.

BRLC was formed in 2011 with help from The Nature Conservancy of Utah and the Bridgerland Audubon Society, and immediately embarked on a flagship project which protects 500 acres of riparian habitat along the Bear River in Cache County. BRLC has also protected a quarter-mile of Bear Lake shoreline that protects another 50 acres of emergent marsh, facilitated a 7.5 acre wetland mitigation project along the Bear, and purchased farmland in Mendon, Utah to protect a threatened orchid, Spiranthes Diluvialis. We work with landowners who hope to permanently save their land from development. Key to each transaction is identifying public values that future generations will value. Specifically, we look for:

- Critically important habitat, especially the increasingly rare habitat along riverbanks
- Working farms and ranches which provide open space and slow the advance of suburbs and other forms of urban sprawl
- Public recreation including birdwatching, hiking, river access, hunting, and fishing
- Historic lands that tie us to our heritage

Developers can afford to pay many of these landowners tremendous prices for their land. Bottom line, we have to be able to compete with that in order to incentivize these landowners to save their land. Thanks to the Enhanced Federal Tax Incentive for Conservation Easement Donations that was made permanent by Congress in 2015, in addition to keeping their land the way they always have, landowners can receive significant tax benefits for accepting a conservation easement. The benefits we protect are considered by the IRS tax code as public benefits, and placing land which provides those values into an easement is seen as a charitable donation.

For landowners who are land-rich and cash-poor, tax benefits may not be enough. In states like Colorado,

a state lottery generates millions of dollars annually for land conservation, much of which gets funneled to landowners in order to partially compensate them for protecting their land from development. If property under easement is sold, the conservation easement 'runs' with the land, and the protections bind all future owners as well, ensuring that the land's values for the public endure forever.

In Utah, sources of public funding, which act as matches for federal monies for critical land conservation have dried up. The LeRay McAllister Critical Land Conservation Fund has not been well-funded by the legislature for years, though land trusts in Utah are continually working to re-establish it. Summit county passed a county ballot initiative that provides local match funding by way of a general obligation bond, and a similar effort was attempted in Cache County in 2008, though it narrowly failed amidst the fears surrounding the 2008 financial downturn.

With every acre BRLC saves near the Bear River in Box Elder, Cache, and Rich counties, we get a step closer to lasting protection for the Great Salt Lake's largest source of fresh water. Ultimately, as the population of Northern Utah continues to grow, the Bear River that passes through all three counties of our service area will be pushed to the limit. We hope to slow the degradation of the Great Salt Lake's largest tributary by protecting natural spaces from development and an increasing population. If nothing else, we know our efforts will highlight the need to develop responsibly.

To learn more about BRLC and our important work in Cache, Box Elder, and Rich Counties, please visit our website: BearRiverLandConservancy.org. There, you can view our video, read past newsletters, contact us, and learn how you can donate time or money to the mission of saving the land we all rely on every day.

BRLC is also seeking its first professional Executive Director. For more information please visit www.BearRiverLandConservancy.org/about-us/staff

Trevor Irish is the Director of Community Engagement for the Bear River Land Conservancy

Restoration work on the Bear River Bottoms, courtesy Trevor Irish

My Spiral Valentine, 2014

The dogs are twin stars, furred, spinning around spinning. They run down the hill to the jetty five times before I reach the bottom, weaving through basalt boulders and dry clumps of rabbit brush and sage. By the time I am finally down the hill, Stella, an Australian shepherd/border collie, Wyoming meth mutt has found a dead thing, a gull matted into grasses and weeds, feathers the blended color of the grasses. The dog rolls in the crater of the gull's body. She pushes into scent, trying to become it, then steps away into tracks of the jetty, perfumed with musk, smiling her giddy clown smile.

Staggered with love loss, I drove this morning to Rozel Point to walk Spiral Jetty with my dogs. The golden retriever Winston, troubled by the washboard road, ended the drive by squeezing through the gate in the back of the Subaru and tumbling into the front seat, his tongue waving and one paw in my lap. My hand on his shoulder kept the rest of his ninety-pound body from pouring into my lap while I negotiated the gravel road, catching first sight of the lake—a shard of sapphire settled in gold, shadowed hills, flattened map of the earth, shimmering.

Now, Winston works in tandem with Stella, measuring the Spiral Jetty with an old dog's sprint and undulation, arabesques of blond fur and tongue wagging, caramel nose smelling the world he will leave too soon. Stella zips around him like a wild, speeding kite. I have always loved the jetty itself but found its purpose to spin us toward the flats beyond it, where the lake hovers in a thin sheet of light at the horizon. The dogs and I walk crackling salt, hard white crystal infused with peach and blush toward that light.

The crystalline floor takes the sheen of water. It begins to reflect the sky a hundred yards from the lake itself. Water fills each fissure and indentation, water a half inch shallow, beginning to absorb color and depth of the sky. I take off my shoes and socks, my feet negotiating jagged salt until the water deepens and salt turns soft. It is February, but sunlight makes the cold bearable. A little more water, then a snow-drift of salt rises, flanking the flat shore like blown silk.

I step into it, walk in its billow, feet sinking in salt and water like snow but warm as the air. The dogs walk in front of me, woven counterpoint to white salt drifts contoured with a spectrum from coffee to amber, pale shell pink overtaken by blue sky mirrored. White sunlight makes whole mountains disappear twice. Both dogs walk that way toward what I cannot see. Stella lies down in salt, dangling her feet in coffee color and orange. Her body curls along the curl of salt, her own markings wrapping her body, sfumato teak to oak, white snout, black nose, magpie blue-black. In motion, Stella seems to run on water, little Jesus dog miracle. Then, she lies down, rests, one white paw with sleeves of tan fur over the other.

I look away from the sun. Golden Winston stands, honey chest and heart pushing toward tawny hills of Rozel Point stippled in black rust rock, weighed down by blue clouds. Stella sits before him, a bowl of fur and teeth and tail and pleasure.

This moment, the three of us are perfect.

Loss fills in with light and color. The golden dog is alive; he can run; he can roll in salt and dirt, open his mouth wide to the air. Less than two years, he will be gone. I cannot weep except for light, except radiant fur and the huffing of two dogs who follow me, who lead me. These dogs, my pole stars, slip through blur between the palpable and its ethereal reflection. They give depth to the distance of the lake. They pull my own heart toward that blue horizon, shaking sorrow away, shaking away the sorrow to come. Here, I understand the shape of beauty, the breadth and transience of it, and how small sorrow like mine disappears in pink salt and water, the powder breath, blue, this gift of lake water and the hand the holds it.

Joel Long teaches Creative Writing and twelfth-grade English at Rowland Hall.

The 2017 Doyle W. Stephens Scholarship Award
The Gift that Keeps on Giving

All smiles - Melissa, Melody and Lynn
courtesy Charles Uibel

On May 18, FRIENDS of Great Salt Lake awarded the 2017 Doyle W. Stephens Scholarship to Melody Lindsay, a Ph.D student at Montana State University, for her research titled "Effects of Changing Salinity on Microbialite-Associated Primary Producers and Secondary Consumers in Great Salt Lake". Melody and her advisor, Dr. Eric Boyd, braved a late-spring snowstorm to make the trek from Bozeman to accept the award.

The award event, held at Westminster College's Gore Auditorium, was enjoyed by an audience of students, professors, state agency and USGS scientists, and FRIENDS members, friends and family. Highlights of the evening included a reception provided by Red Rock Brewery (thanks again, RRB!) and presentations by Derek Mallia, the 2016 scholarship recipient, and Anna Rasmuson and Logan Frederick, Ph.D students at the University of Utah in the Department of Geology and Geophysics who have been hired by FRIENDS through a EPA Technical Assistance Grant to help communicate to our community and stakeholdes the technical details of the US Magnesium facility cleanup and the complex processes involved.

The Doyle W. Stephens scholarship was established in 2003 to honor the memory of Doyle Stephens, a U.S. Geological Survey Research Hydrologist whose long-reaching contributions to understanding the Great Salt Lake ecosystem belie his too-short career. The scholarship was also intended to catalyze scientific interest in the Lake, help develop collective wisdom about this remarkable resource, and support informed policy-making. Lofty aspirations for a $1,000 scholarship? Yes! But this year's event demonstrated just how relevant, thought-provoking, and meaningful the Doyle Stephens scholarship is.

Derek Mallia is a Ph.D student at the University of Utah, and the 2016 recipient of the Doyle W. Stephens scholarship. Derek's presentation on his work "The Impacts of a Shrinking Great Salt Lake on Future Air Quality" included a visually engaging "flyover" look at how lake levels, dust sources, and atmospheric patterns interact to influence dust storm frequency and severity along Wasatch Front population centers. Derek's modeling work could serve as a valuable tool to build on as Utah evaluates the potential public health consequences of the proposed Bear River water project that would further reduce lake levels.

Logan Frederick and Anna Rasmuson's presentation about the US Magnesium Superfund site generated a great discussion. Attendees expressed concern upon learning about the extremely acidic (pH of 1) conditions that exist on the site and the extent of contamination therein. First, we now know that unlined waste ponds are creating a contaminated ground water plume consisting of the acid stream and other toxic contaminants. And that EPA and the Division of Water Quality approved the construction of a HDPE (high density polyethylene) barrier wall to contain the plume. Second, we know that the acid waste ate through the side wall of the pond at the surface and contaminated Skull Valley water discharge into Great Salt Lake, for which DWQ issued a Notice of Violation. To fix this, the plant has diverted its waste stream away form the Skull Valley discharge. And third, what we didn't know much about but do now is that there is a bed of oolitic sand beneath the canal that conveys the acid waste to the ponds, and that the sand has been dissolved by the acid and has served as a channel to transport the acid

beneath the surface for at least ¼ mile, resulting in a discharge onto BLM land to the north of the plant. However, the full extent of the spread of the contamination isn't known and will have to be remediated by US Magnesium. As a fix for this, the company is proposing to pipe the discharge to the ponds and decommission the problematic canal system.

Melissa Barbanell, an attorney, FRIENDS board director and US Magnesium Committee chair, contributed insights into the Superfund legal process and the roles that agencies and citizens play in advocating to resolve problems at the facility. US Magnesium is the only magnesium producer in North America and harvests lake brine to produce magnesium for use in cars, tools, and computers. Stay tuned for further opportunities to learn more about the US Magnesium issue, and check out the technical team's presentations at http://fogsl.org/advocacy/us-magnesium/item/551-annotated-presentations

This year's Doyle Stephens scholarship applicant pool consisted of 8 student researchers – all women! – representing 6 different universities; 3 of them from out-of-state. This geographic diversity speaks to a broadening research interest in exploring the mysteries of our inland sea, and FRIENDS is excited to award the scholarship to our first out-of-state recipient this year.

Melody Lindsay is a highly worthy and multi-talented scholarship recipient. Fun facts about Melody: in addition to being an accomplished scientist with 5 peer-reviewed publications already under her belt, she is also a professional harpist and has done research in 4 kilometer-deep mines in South Africa! We look forward to hearing about her Great Salt Lake discoveries when she presents at the 2018 Great Salt Lake Issues Forum, May 9-11 at the University of Utah Ft. Douglas Officers Club.

Melissa Stamp is a FRIENDS board director and co-chair of the Arts and Science Committee

Dr. Bonnie Baxter, Dr. Eric Boyd, Melody Lindsay courtesy Charles Uibel

Anna Rasmuson, Technical Advisory Team, and friends courtesy Charles Uibel

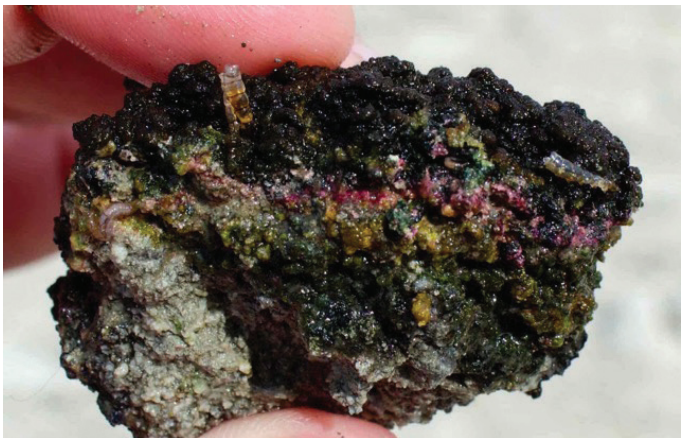
Great Salt Lake At A Glance

Courtesy U.S. Geological Survey

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.

Great Salt Lake: Productive on Many Levels

I live in Bozeman, Montana, where I have the opportunity to conduct research on extreme environments and the microorganisms that live in those environments (extremophiles) as a doctoral student in Dr. Eric Boyd's geobiology laboratory at Montana State University. My thesis research is highly interdisciplinary, incorporating facets of geology, chemistry, and biology as they interact to define the ecosystems I study. Great Salt Lake (GSL) is no different in this regard - it lies at the intersection of geology, chemistry, and biology, and of research, industry, and conservation. As the newest recipient of the Doyle W. Stephens Scholarship, I will continue research on GSL microbialites, focusing on how these carbonate-biological entities interact with and influence the dynamic ecosystem of GSL, maintain the ecosystem's health, and preserve the economic vitality of the brine shrimp industry.



Layers and trophic levels displayed in a microbialite cross section courtesy M. Lindsay

Research on Great Salt Lake Microbialites

Although the enigmatic grey carbonate structures observed on the edges of GSL have been referred to as bioherms/biostromes, microbially-induced organosedimentary structures, and "fairy rings", we classify them as microbialites due to evidence for microbial processes constructing these lites (or rocks). While the microbialites of GSL may not be as famous as microbialites in Shark Bay, Australia or Highbourne Cay, Bahamas, they represent one of the largest extents of such structures on earth, covering ~20% of the GSL floor. GSL microbialites are sometimes only visible when water levels are low enough to expose outcrops, but most remain covered in shallow water year-round. Many researchers are newly focused on GSL microbialites due to their interdisciplinary research potential and importance to the ecosystem, especially focused on the role of photosynthetic microbial primary producers that support middle trophic level species such as brine shimp (Artemia) and brine flies (Ephydra), to terminal trophic species encompassing bird species.

Pass the Salt – Salinity Matters, as do Railroads

A recent paper out of our lab investigated the differences between microbialite communities along salinity regimes in the North and South Arms of GSL (24% - 31% and 11% - 14% salinity, respectively), which largely exist due to the railroad causeway constructed in 1959 across the lake [1]. Using next-generation molecular biology and mineralogical techniques, we performed in-depth characterizations of the microbialite-associated communities and the carbonate structures from a high salinity site in the North Arm and a lower salinity site in the South Arm. Our conclusions were that South Arm microbialites are still actively forming due to the presence of several species of photosynthetic organisms (primary builders of the structures), but that North Arm microbialites are not actively forming due to the increased salinity inhibiting those photosynthesizers. These findings point to the importance of these photosynthetic primary producers in supporting the entire lake ecosystem, as brine shrimp and avian populations rely on the primary producer biomass of the microbialites as food sources. Even to the naked eye, different types of non-primary producing microbes as well as higher trophic level species (Ephydra) can be observed within a microbialite cross section, and perturbations to the ecosystem could disrupt this economically and environmentally important food web.

Potential Trophic Effects of Changing Salinity

GSL is constantly in a state of flux – changes in precipitation or water usage in the greater GSL area likely affect the overall productivity of GSL by impacting the salinity, which in turn impacts the productivity of the primary producers and secondary/tertiary consumers. In my Doyle W. Stephens scholarship application, I proposed to investigate the effects of changing salinity on the level of primary and secondary productivity of microbialites. Specifically, investigating how changing salinities in GSL may affect the composition and productivity of GSL microbialite communities and how this in turn affects the secondary production and abundance of Artemia brine shrimp populations in controlled experiments. While drastic changes in the flora and fauna of the lake in response to changing lake levels and salinity have been observed historically (even allowing a population of fish to inhabit GSL for a short period of time) [2], I am going to quantitatively determine how such changes might influence the primary producer communities associated with constructing the microbialites and which support a large portion of the lake ecosystem.

Importance of Great Salt Lake Microbialites for Understanding Early and Contemporary Earth

Another claim-to-fame is that fossilized microbialites represent some of the oldest evidence for life on Earth, with evidence indicating their presence by 3.5 billion years ago [3] and new, debated evidence suggesting that these communities existed 220 million years earlier [4]. Research into active contemporary microbialites such as GSL microbialites not only provides insights into the GSL ecosystem, but also informs our understanding of processes that may have been involved in the early evolution of life on Earth. I am incredibly honored by the support from FRIENDS of Great Salt Lake and my colleagues at the Great Salt Lake Institute at Westminster College, especially Dr. Bonnie Baxter and Jaimi Butler. I'm also pleased to recognize the vast support for this research poised to inform our understanding of the processes that influence GSL ecosystem dynamics. As is well recognized by numerous GSL researchers, particularly Dr. Wayne Wurtsbaugh, the microbialite components of this ecosystem represent an integral component to the functioning of GSL on levels that encompass economics, conservation, and basic research. I'm grateful for the continued opportunities to conduct research on these unique structures and hope to make a significant impact on our understanding of this unique ecosystem, which has the strong potential to provide new insights into the role of microbialites in past, present, and future ecosystems.

Melody in her element of GSL microbialites courtesy M. Lindsay

Melody R. Lindsay, Ph.D. Candidate, NASA Earth and Space Science Fellow Boyd Geobiology Lab, Department of Microbiology and Immunology, Montana State University

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A Lost Positive - Whatever Happened to Locomotive Springs?

Courtesy R. Jefre Hicks

As a young man back in the 1970's, much of my youth was misspent with friends out in the desert around Locomotive Springs. We spent hours and hours each weekend out near the old abandoned rail line that runs along the northern edge of the Great Salt Lake. My trusty Toyota Starlet was the perfect vehicle for such adventures due to its light weight (which came in handy when we needed to lift up the car to dislodge it from a clump of sagebrush) and the fact that it got incredible gas mileage. We explored a lifetime's worth of interesting structures out along the old rail line...including the ghost town of Kelton, which still had remnants of old buildings and a very old, very small cemetery. Rabbits and coyotes were plentiful, and, while hunting rabbits, we discovered many seasonal creeks and ponds. It didn't take long before we discovered ducks and geese on the springs and impoundments of Locomotive Springs.

In the 70's and 80's, as I recall, the Locomotive Springs were brimming with waterfowl. The massive expanse of salicornia flats and playas were crawling with so many shorebirds and assorted other waterfowl that it looked like an ant colony that had been disturbed with a stick...basically it was a writhing mass of bird life feeding on a food source that had sustained their migrating ancestors for millennia.

In the 1880's, Locomotive Springs got its name because the gushing spring waters roaring up out of the rocks sounded like a train coming down the tracks. The land was originally federal property, but it was eventually transferred to the state in an agreement that ultimately allowed state ownership of Locomotive Springs and Public Shooting Grounds. Historically, it is known that the native people enjoyed the flowing springs for many generations. Later, migrant railroad workers also enjoyed the springs during their time building the railroad, as did a few hardy travelers that made it out there on the rough dirt roads. Later, in its infinite wisdom, the government decided that this sparkling jewel in the desert needed to be improved and protected. As part of a federal government work project, there were, at times, around 1000 workers camped at Locomotive Springs as they labored to create impoundments out of dirt and wooden planks. These workers also dug water-delivery canals to fill the newly built ponds with the abundant spring water. Upon completion, they had built three man-made impoundments, and these new ponds were filled with water from the six natural springs in the area. Due to its beauty, rarity, and significance to migratory birds, the state designated approximately 18,000 acres as "Locomotive Springs Waterfowl Management Area".

Thousands of Utah citizens enjoyed "Loco Springs" in its heyday and some traveled great distances to experience the wonder of a desert oasis. Some folks even flew in and landed on an old airstrip at the springs. The Division of Wildlife Resources (DWR) decided to start stocking five of the six springs with rainbow trout, and it quickly became a destination for folks looking to spend a day afield. There are reports of over 4000 fishers visiting the springs annually, and some days there would be over 100 people fishing in the springs and their outflows. The area was also a very popular camping spot for families as they spent their weekends fishing, hunting and bird watching. In addition to the geese and ducks, an observer could easily see sand pipers, snowy plovers, stilts, curlews, avocets, and a variety of other shorebirds. Of course there were always eagles and hawks hanging around the area searching for an easy meal.

As it is with "progress", farmers in the Curlew Valley

around Kelton, Snowville, and Stone, Idaho soon discovered that they could grow alfalfa in the desert if they drilled wells into the aquifer. To grow huge amounts of alfalfa, the landowners needed to poison and plow out the native sagebrush in the area. Soon, there were fields of hay where sagebrush and sage grouse once proliferated. Not long after that, Locomotive Springs started getting drier and drier each year. DWR warned the State Water Engineer that continued pumping of the aquifer would have detrimental effects on the Waterfowl Management Area, but even more water rights were granted, more irrigation pivots were installed, and more water was pumped. The state conducted an aquifer study in the area about 16 years ago and found that irrigation pumping had reduced the flows of the springs by over 83%, and the reductions have only intensified since then. Now, with the knowledge that most of the alfalfa around here is sold and shipped overseas, I believe it is safe to say that our public water (the water nature intended to reach Locomotive Springs and the Great Salt Lake) is being sold overseas in the form of alfalfa.

Due to the lack of water in the area, migratory birds' traditional food sources such as salicornia, salt grass, and bulrush have been drying out dramatically. Nowadays, the springs barely exist and the impoundments only receive water if it rains. Only one spring now has enough water in it to trickle out into the world beyond its banks.

It's been many years since I've seen any water in the traditional channels stretching from the springs to the Great Salt Lake. With the loss of native food sources, the sea of shorebirds that used to scuttle about on the playas and flats are few and far between. Most of the ducks and geese have stopped using the WMA as a migratory stopover, and, although the DWR still stocks a couple of ponds, there are almost no fishers venturing out there to try their luck. Of the thousands of people that used to enjoy this beautiful area of state-owned public land, only a few travel out there now. Sadly, it seems that getting a Waterfowl Management Area designation wasn't quite enough to withstand the economic pressures that are put on our public water.

The great state of Utah had a chance to preserve a rare shimmering wetland treasure in the desert but chose to let it die a slow death in order to allow a few farmers to profit from growing alfalfa. The landowners in the area fared well, but the thousands of Utah citizens that enjoyed Locomotive Springs WMA ended up with nothing but devastation...at least we still have our memories.

R Jefre Hicks is a waterfowler, member of the Utah Airboat Association, and former board director with FRIENDS of Great Salt Lake.

Remnants of the oringinal wood-plank dikes built to impound Locomotive springs
Courtesy R. Jefre Hicks

Courtesy R. Jefre Hicks

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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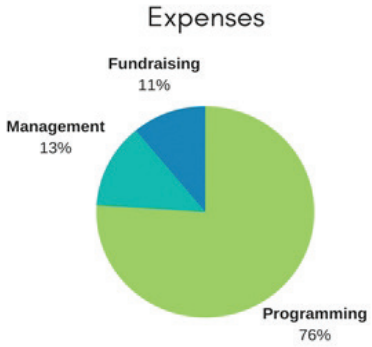

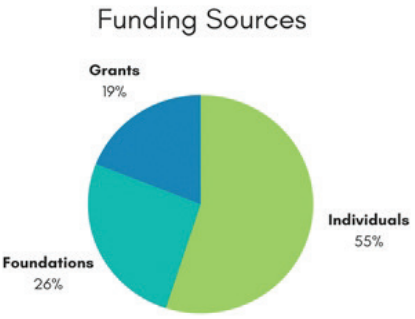

Bouyancy
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Submitted for the 2015 Alfred Lambourne Prize

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