

# FRIENDS of *Great Salt Lake*

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*Spiral Jetty Memorial Service* by Jenny Mauro Hicks

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

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# EXECUTIVE DIRECTOR'S MESSAGE

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## RED FLAGS SHOULD LEAD TO GOOD SCIENCE:

### The Merits of Pattern Recognition and the Mercury Issue

"We need to initiate a systematic study here to understand what's going on."

John Whitehead, Chairman of the Utah Mercury Work Group

#### Red Flag #1

It was reminiscent of a classic "Wanted: Dead or Alive" poster except instead of two human faces staring back; there were two ducks placidly floating on water. "WARNING: Avoid Shooting or Eating Northern Shoveler and Common Goldeneye from Great Salt Lake. "Coordinated efforts between the Utah Dept. of Health (DOH), the Department of Environmental Quality (DEQ) and the Division of Wildlife Resources (DWR) were responsible for the publication of this Consumption Advisory. Utah is the only state to have issued such an advisory.

Extremely high mercury levels had been detected in these two species of ducks commonly found on GSL where one third of the Pacific Flyway frequents. One shoveler collected in 2005 had a mercury concentration of 11.7 mg/kg. This is 39 times the EPA "level of concern" for human consumption (0.3mg/kg).

At the time of this release, aerial surveys indicated that there were more than 450,000 ducks on the Great Salt Lake wetlands. What is interesting about these two species is that they each have different foraging patterns; shovelers are dabblers and goldeneyes are divers. This suggests that mercury could exist in multiple trophic levels in the ecosystem .

Luckily, the warning was issued one day before the start of the Utah duck hunting season.

#### Red Flag #2

Reconnaissance research done in 2003 by US Geological Survey (USGS) and the US Fish and Wildlife Service (USFWS) of sediment and water samples from the deepest part of Great Salt Lake and brine shrimp and the livers of eared grebes, revealed extremely high levels of methyl mercury in these sources. At that time, they were the highest levels of methyl mercury ever detected in the U.S. In 2005, Kennecott tested for mercury in shallower waters near their GSL outflows. The results exceeded the USGS-reported levels..

#### Red Flag #3

Utah issued its third fish advisory in November 2005 after 8 of 10 channel catfish from the Green River in Desolation

Canyon exceeded levels of mercury considered safe for unlimited consumption by EPA. In August 2005, the state issued its first public health advisory for fish after finding elevated levels of mercury in largemouth bass from Gunlock Reservoir in Washington County and brown trout in Mill Creek near Moab. Utah became the 46th state to issue a fish advisory.

Unfortunately, there are numerous examples of elevated levels of mercury just about everywhere around the planet; in the air, the water, sediments, biota, tissue and human hair.

So how do we begin to chip away at what seems to be such an insurmountable task?

Authorities have suggested a three pronged approach (ah, western culture) to addressing the problem. This approach consists of characterizing the risk; what things are out there that could endanger human health? Identify the sources and pathways: what are the activities causing the emissions and vehicles for transmission? And identify the potential solutions; what recommended outcomes and responsible actions must be taken using the tools of good science?

Characterizing the human health risks means more sampling of fish, ducks, water and sediments; more analysis and more funding to support the scope of work involved. The state appears to be sincerely committed to taking such steps but there are funding questions with may preclude some of the necessary breadth of this effort. The state's hefty budget surplus would have been a wonderful source of additional funding toward this much needed program.

However, thanks to DEQ and DWQ, the State Department of Health laboratory is now equipped with the necessary instrumentation to detect mercury in tissue samples. The mercury analyzer will save both time and money by not having to send samples out of state. The lab is currently working on the tissue analysis of waterfowl collected in December 2005; part of a succession of waterfowl sampling from Great Salt Lake that the DWR has under taken.



DWR sees this waterfowl sampling as a huge and challenging opportunity which will require continued discovery to help the division determine what the next steps should be. Four general areas of the Lake will be sampled; Farmington Bay, the Greater Ogden Bay, Bear River Bay and the open waters of the Lake. The waterfowl sampling plan reflects an attempt to capture the dynamics of the presence of waterfowl that use Great Salt Lake from late summer through the spring. Additional species of duck such as the green teal will also be included. The results should be available by the end of this spring.

Since 2000, nearly 300 samples of fish were taken from locations around Utah. Additional fish samples taken from 22 sites in 2004 and 66 sites in 2005 will be analyzed at the State Lab. Four new sites; Calf Creek in Capital Reef, the East Fork of the White Rocks River, Deer Creek and Pleasant Creek will be added for sampling. It was suggested during one of the State Mercury Work Group meetings that striped bass from Lake Powell should be included in future sampling protocols.

Additionally, both USGS and USFWS are seeking funding for proposals that will provide even more clarity to the sources of mercury emissions in the environment. Working in tandem, these researchers are looking more intensively at Great Salt Lake and the eared grebes that double their body weight on brine shrimp during their winter migration. The team is also exploring partnering efforts with Nevada to investigate long-term mercury deposition in both states and the implications to aquatic biota and potential human health effects.

Identifying the sources and pathways of mercury contamination is critical to determine what activities are causing the problem. Most of us recognize that potential atmospheric sources of mercury emissions include coal fired power plants, legacy mining operations, ore roasting in gold mining, waste incineration, volcanic activity and even evaporation from the oceans. So at the very least, as we begin to grapple with our own back yard concerns, we should be talking with our neighbors in Idaho, Nevada, California, Oregon, Montana and Washington.

The Utah Division of Air Quality has started doing that. Currently, Utah is working with Idaho and Nevada (Region 8, 9 & 10) to gain a better understanding of mining activities and impacts from their emissions. Nevada is involved in a rule making process to regulate mercury emissions from gold ore roasters. Since gold mining operations in northeastern Nevada have been identified as one of the possible sources of mercury contamination in Great Salt Lake, DAQ is very interested in tracking this process.

The key to the outcome will be the amount of regulatory teeth involved or whether it will only be a voluntary program. Much to its credit, Nevada has managed to halve its mercury emissions through voluntary measures and that's encouraging.

Coal fired power plants seem to be in a league of their own when it comes to emitting mercury because although there are standards to regulate emissions from most heavy industrial sources, there are none for coal fired power plants. They too are a major contributor.

In the late 1990's, Congress ordered the EPA to create a rule to cap mercury emissions from this source. In early 2000, the EPA was proposing to release a rule for such a cap and which would reduce mercury emissions upwards of 90% by 2008. However, the Bush Administration interfered with this legislation. When the revised rule was released in March 2005, it pushed the restriction cap to 2018. This means that restrictions on mercury emissions from coal fired power plants is voluntary until then.

"Trade and cap" dynamics; trading pollution credits to forestall technological upgrades in coal fired power plants is something we should all be concerned about. As we look forward to new plants coming on line in Utah and Nevada, this practice has the potential to create mercury "hot spots" throughout the region.

DAQ is mindful of this and is working tenaciously to gather more information to help establish a mass balance approach to determine how much mercury occurs and how to address impacts in the region from these sources. They don't want to wait for sources to squeeze out as much mercury as possible before taking action.

So, in a nutshell, we are on the verge of some very promising commitments to gather good science and get good results. But that's just one part of the solution. The other part of the solution is a commitment from us of time, energy and support to see this huge responsibility through. Only through a unified effort can we all celebrate a sense of accomplishment and a job well done. 🐾

In saline,

Lynn de Freitas

# FRIENDS ORGANIZATIONAL STATEMENT

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

FRIENDS has a very active Board of Directors and an Advisory Board consisting of professionals in the scientific, political, literary, education, and broadcast communities. Founded in 1994, we have organized and sponsored an array of programs, activities, and materials in pursuit of our mission.

Since 1996, we have sponsored a biennial Great Salt Lake Issues Forum that provides a gathering for policy makers, researchers, planners, industry and other stakeholders who are involved in and concerned about the Great Salt Lake.

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.

In 1997, we hired Bruce Thompson as our Education Director and initiated a major 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 slideshow program "The Lake Affect: Living Together Along the Shores of Something Great." Over 11,000 people in the five counties surrounding Great Salt Lake have seen the program.

We hope that the DVD version of The Lake Affect, and Project SLICE, a 4th grade curriculum using Great Salt Lake as a system of study, will achieve a positive, long-lasting impact on the future of the Great Salt Lake and those who dwell upon its shores.

In 2003, FRIENDS awarded the first Doyle W. Stephens research scholarship. Until his death in May 2000, Stephens served as a research hydrologist for the U.S. Geological Survey. He is particularly remembered for his work toward increasing public awareness of the Great Salt Lake Ecosystem.

FRIENDS was awarded the Conservation Achievement Award by the Utah Chapter of the Wildlife Society in 1998. 🐾

## On the Cover

*Spiral Jetty Memorial Service* by Jenny Mauro Hicks, 10/29/2005

This photo was taken during a memorial service for a good friend, an adventurous man who felt a kinship to this particular spot on the northern end of the Great Salt Lake. The dark sky had recently broken into sun and the morning storm had left the ground rich with contrast. As the sun set we made the trek out to Robert Smithson's land art and silently reveled in both memory and beauty.

Among other things, I am a full-time mommy to two spirited young girls and a part-time artist and web designer. I dream of a week in the desert.

More photos from this day: [www.sunboxstudio.com/mt/jen/archives/000481.html](http://www.sunboxstudio.com/mt/jen/archives/000481.html)

# 6TH BIENNIAL GREAT SALT LAKE ISSUES FORUM

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## SALT LAKE CITY & BRIGHAM CITY, UT - MAY 4, 5 & 6, 2006



*Great Blue Heron by Art Morris*

### Range-wide Migratory Bird Conservation and Great Salt Lake's Role in Linking Partnerships Within the Western Hemisphere

*"Bird migration is the one truly unifying natural phenomenon in the world, stitching the continents together in a way that even the great weather systems, which roar out from the poles but fizzle at the equator fail to do."*

*Living on the Wind - Scott Weidensaul*

Join FRIENDS of Great Salt Lake for a hemispheric perspective about ongoing efforts to promote migratory bird and habitat conservation in Canada, Mexico and the United States. Learn about the research and community efforts to fulfill the promise that habitats will be there when the migratory birds arrive.

#### **Keynote Speakers:**

**Brad Andres**, USFWS National Shorebird Coordinator - "Examples Across the Hemisphere That Illustrate Partnering Approaches to Bird Conservation."

**Ian Davidson**, South American Coordinator for Bird Life International - "Building Partnerships for Neotropical Bird Winter Range Conservation, a Latin America Perspective."

**Charles Duncan**, Director WHSRN Executive Office - "The Western Hemisphere Shorebird Reserve Network: An International Strategy for Local Conservation."

More details are available at [www.fogsl.org](http://www.fogsl.org) or call 801-593-5593.





# 2006 GREAT SALT LAKE ISSUES FORUM

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*Willet* by Rosalie Winard

## SCHEDULE OF EVENTS

### WEDNESDAY, MAY 3rd

**"Killer Flu" - Best Documentary, Cannes Film Festival**  
Free Public Viewing. Salt Lake City - Venue T.B.A.

### THURSDAY, MAY 4th

**Reception/Dinner and Panel Discussion**  
The Alta Club. 5:30–9:00 pm

#### Discussion Topic:

**Avian Flu** - What is it? Why should we be concerned?  
What are public health officials doing about it? What are the implications for migrating bird populations?

#### Panelists:

**Dr. Robert Rolfe**, State Epidemiologist  
What is it and how is the State preparing for it?  
**Dr. Mike Marshall**, State Veterinarian  
Is the Utah poultry industry at risk?  
**Leslie McFarlane**, Wildlife Disease Specialist, DWR  
What are the implications for migrating birds?

### FRIDAY, MAY 5th

**Community Efforts and Programs to Promote Migratory Bird and Habitat Conservation.**

**Evening Reception Dinner and Keynote**  
**Charles Duncan** - keynote speaker  
**Doyle Stephens Scholarship Award**  
**Friend of the Lake Award.**

### SATURDAY, MAY 6th

**Importance to Migratory Birds of the Three Linked WHSRN Sites and Associated Research.**

Friday and Saturday Issues Forum Program will be held at the James V. Hansen Wildlife Education Center, Brigham City, Utah.

Program details available at [www.fogsl.org](http://www.fogsl.org)

## REGISTRATION

Covers all events, meals and receptions  
**Early Registration** (before April 21) - \$90  
**Normal Registration** (after April 21) - \$120

# SAMPLING FOR MERCURY IN GREAT SALT LAKE

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## WELL WORTH THE TIME AND EFFORT

During the past two years, the Great Salt Lake has received national and international notoriety as a result of mercury data initially released by the U.S. Geological Survey and U.S. Fish and Wildlife Service (Service), and more recently by the health advisory issued by the state of Utah which warned people to not eat two species of waterfowl (northern shoveler and common goldeneye) harvested from the lake. Mercury is a topic that has captivated national interest and has people talking about issues such as fish advisories, emissions standards, gold ore processing, and even China. The findings from the Great Salt Lake have also captured the attention of many, especially those in Utah, in part due to proximity, but also because the data raise additional questions.

One of the primary questions is “where is the mercury?” Actually this is a series of questions such as 1) what are the concentrations in the lake, in the wetlands, and in biota; 2) are some areas higher in mercury; 3) do certain species accumulate mercury more than others, or are differences tied to foraging behavior, foraging location, and/or trophic level; 4) what role does migration play in the uptake and accumulation of mercury in birds; and 5) what are the implications for human health? Another basic question is “has the mercury always been there?” And finally, if not, “where is it coming from?”

These questions will not be answered overnight, but will likely take several years of collaborative research to even begin understanding the basic subject matter. However, data already collected by the Service may provide insight into the question of mercury distribution. Between 1996 and 2000 the Service collected hundreds of samples in the wetlands around the Great Salt Lake. These samples included avian eggs, fish, invertebrates, and sediments. The samples were analyzed for a host of contaminants, including mercury. Overall, mercury concentrations were low in nearly all locations and in most samples. There were, however, elevated concentrations of mercury near the mouth of the “Northwest Oil Drain” near the Crystal Unit in Farmington Bay Waterfowl Management Area, and in a few other sediment samples. But for the most part, mercury was not present in wetlands in ‘alarming’ amounts.

The above referenced study suggests mercury may not currently be an issue for wetlands surrounding the Great Salt Lake; however, additional study is warranted. But based on available information it is unlikely that we can say the same thing about mercury for the open water of the lake. In Great Salt Lake water, methyl mercury concentrations as a percent of total mercury were among the highest ever measured by USGS (methyl mercury is the bio-available form of the metal that is most toxic

to humans and animals). In addition, preliminary data collected by the Service indicate that mercury concentrations in the livers of eared grebes may increase while the birds reside on the lake. Finally, samples of breast muscle tissue collected by the Utah D.W.R. from two species of duck on the lake (northern shoveler and common goldeneye) contained mercury concentrations that were so high that the State issued a health advisory advising people to not eat them at all. These three lines of evidence indicate that mercury is a concern for the open water of the Great Salt Lake and that additional investigation is needed.

As an initial step in this investigation, the Service has acquired funding to take a closer look at the dynamics of mercury in eared grebes on the lake, and to identify bioconcentration and bioaccumulation factors between water, brine shrimp, and birds. Eared grebes were selected because their migratory patterns and foraging behavior make them an ideal test species. In the fall, eared grebes arrive on the lake where they undergo a molt and become flightless; for the next three to four months the birds spend almost all of their time on the water and eat brine shrimp almost exclusively. Because grebes do not continuously migrate into and away from the lake, and because they forage wholly from the lake for an extended period of time, these birds are potentially exposed to water-borne mercury on the lake and may represent a “worst-case scenario” for evaluating mercury accumulation in an avian species on the Great Salt Lake. This study will also provide additional data on mercury concentrations in the water and food chain components (e.g. algae and brine shrimp) within the lake.

Still, we recognize that this study is limited: the eared grebe is only one of many avian species that use the lake, that its migratory patterns and foraging behavior are unique (not all species spend as much time on the lake), and that grebes are not consumed by humans. However, data gleaned from this study will be informative for other birds that use the lake such as waterfowl (e.g., northern shoveler and common goldeneye) and shorebirds (e.g., American avocets and Wilson’s phalaropes). The Great Salt Lake is a dynamic and complex system and is a valuable resource that is used by millions of migratory birds. This complexity means answers will take time, but the value of the lake and the resources it provides suggest the time and effort will be worth it. 🐾

Nathan Darnall,  
USFWS Ecologist

# CONCEPTUAL MODEL AS GUIDANCE

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## DETERMINING A NUMERIC STANDARD FOR SELENIUM

### Introduction

During the Fall of 2005 a science panel of nationally recognized scientists in the area of selenium environmental, avian toxicology and geochemistry (Drs. Anne Fairbrother & William Wurthle - U.S. Environmental Protection Agency, Dr. Joseph Skorupa - U.S. Fish & Wildlife Service, Dr. William Adams - Rio Tinto, Dr. Theresa Presser - U.S. Geological Survey, as well as scientists from Utah Division of Water Quality) were engaged to work with local scientists and engineers (Drs. Michael Conover & Wayne Wurtsbaugh - Utah State University and Drs. William Johnson and Jack Adams - University of Utah) to develop a conceptual model to guide the development of a numeric selenium standard for Great Salt Lake.

### Motivation

The motivation to determine a selenium standard for the open water of Great Salt Lake (GSL) derives from public concern for disposal of contaminants from groundwater cleanup into the South Arm or open water of GSL. The contaminant concentrate contains selenium which can be toxic to waterbirds.

### Existing GSL selenium standard

GSL is protected for its current beneficial uses through the application of the narrative standards. The Utah Department of Environmental Quality (DEQ) has not yet identified numeric water quality standards for Great Salt Lake and fresh water standards do not apply.

### Conceptual model to guide standard development

The development of a water quality standard for selenium requires working knowledge of existing selenium concentrations in the Great Salt Lake, as well as existing and proposed loads to the system. This “working knowledge” is being represented in a conceptual model that describes forms of selenium in the components of the system (e.g. water, sediment, biota) and the “flow” of selenium between stocks (e.g. precipitation and settling, volatilization, bioconcentration). The conceptual model will serve as the basis for a semi-quantitative model that will guide subsequent investigations.

### Loads

The existing selenium loads to the GSL are not well understood. The most prevalent source of selenium nationally is irrigation of marine deposits of Cretaceous to Tertiary age. Since the GSL is a terminal lake, evaporation increases the concentration of selenium in the system. Sources of selenium to the GSL include irrigation runoff, copper mining discharges and refinery wastes.

### How do we measure what's there?

The hypersaline water of GSL presents an exceptional challenge

to analytical techniques used to measure selenium in water. A “round robin” survey of samples from several depths (one location) demonstrated that only a limited set of analytical methods can reliably quantify selenium in this system. The round robin yielded a low value of 0.5 micrograms/L. However, the open water of the Great Salt Lake cannot be represented by a sample from a single location or point in time.

### Accumulated record

The degree to which selenium may be sequestered in non-bioavailable forms in the GSL is important to the assessment of selenium loads to the GSL. Collection and analysis of sediment cores from lakes provides a record of long-term water quality trends. The USGS lake cores in Farmington Bay show pre-1900s selenium concentrations around 0.4 mg/g; with increases of 4 to 5-fold thereafter (David Naftz, personal communication). The significance of this increased selenium accumulation depends on the long-term bioavailability of accumulated selenium. The goal of understanding the distribution of existing and additional selenium loads requires a conceptual model that describes selenium cycling within GSL ecosystem. The conceptual model diagrams how pathways may vary with climate-induced changes (e.g. salinity, redox conditions, etc.), and demonstrates the degree of confidence with which the various components of the cycle are understood.

### Dynamics of the GSL ecosystem

Comprehensive determination of selenium cycling in this system requires an understanding of the following:

- a) The storage compartments of selenium in the system
- b) The residence times of selenium within these compartments
- c) The fluxes of selenium between these compartments
- d) The pathways between these compartments.

The comprehensive conceptual model allows identification of areas where improved understanding of processes is required prior to determination of a selenium standard for GSL. The complexity of the GSL system may yield more potential investigations than can be supported financially or completed in the time allotted. Decision makers will need to rank identified areas of need relative to the ultimate goal of a numeric water quality standard. There are two major considerations in development of the conceptual model:

- a) The GSL system is spatially diverse, being comprised by four distinct bays and two layers. The limited connections between the bays yield major differences in salinity among their waters. Gilbert Bay has a deeper, more saline anoxic zone that “turnover”





more slowly. Farmington Bay also has a deep brine layer that is believed to be mixed periodically during strong wind events (Wurtsbaugh, personal communication).

b) The GSL system is temporally dynamic. Seasonal and inter-annual variations in surface inflow control salinity, shoreline location, and lake depth. Due to the shallowness of the GSL, wind events are also important. Wind events influence vertical mixing of the deep anoxic layer into the overlying water column. Greater than 60% of the lake area is oxic, but a significant portion is underlain by an anoxic deep brine layer. The lateral extent of the deeper anoxic zone appears to expand and shrink on a seasonal basis, potentially exposing sediments to a combination of chemically reducing and oxidizing conditions on an annual basis. Selenium cycling is also biologically driven since the abundances of particular organisms and animals shift from season to season.

### Biogeochemical fluxes

It is likely that selenium moves from the geochemical to the biological system between deep and shallow brine layers. Microorganisms in the water column facilitate the trade of electrons between atoms. In this process, selenium may be chemically reduced when an oxidized form of selenium sorbs to a particle and settles to the deeper anoxic zone. In contrast, reduced selenium may be oxidized when reduced forms are re-suspended into the oxic zone. Also lake area variations may expose anoxic sediment to air, or may submerge oxic sediment beneath the anoxic deep brine layer. The deeper anoxic zone in the GSL has some of the highest sulfate reduction rates measured in a natural system (Dr. David Naftz, USGS, personal communication), suggesting that transformation of selenium in this system is significant, based on the similarities of selenium and sulfur chemistry. A potential release mechanism of selenium from the GSL and sediments is the buoyant transport (upward) of bubbles of reduced volatile selenium (e.g. methylated selenides).

### Into the food chain

The tie between biogeochemical cycling and the food chain in GSL occurs in microorganisms. Brine shrimp and brine fly larvae are expected to take up selenium via the microorganisms on which they feed. The brine shrimp and brine flies are in turn major food sources to birds. Hence, the development of an open water standard involves measurement of selenium concentrations in water, microorganisms, brine shrimp, and brine flies. Preliminary data taken during the summer by Dr. Bill Adams (Rio Tinto) suggests factor of two increases in selenium concentrations in brine shrimp at the south end of the Great Salt Lake during July. This period roughly coincides with depleted d15N (the heavy isotope of nitrogen) measured by Dr. David Naftz (USGS, personal communication). Seasonal changes in food source from green to blue green algae or a shift to a benthic food source growing on stromatolites/bioherms in the GSL need consideration.

### Toxic endpoints

The development of a selenium standard must of course occur with reference to sensitive species at the top of the food chain, i.e. birds. Among the birds present on the Great Salt Lake, three species were chosen: one as a representative of migratory species, and two as representatives of species that breed on GSL.

Eared grebes are migratory species that move between GSL and Mono Lake, the only two lakes in the western U.S. supporting the population of eared grebes in the fall. While they reside on the Great Salt Lake, the eared grebes eat only brine shrimp (99.7% of diet) (Dr. Michael Conover, personal communication). Viability of offspring is likely not a sensitive endpoint for this species since egg laying occurs about 90 days following departure from GSL (in the fall). Eared grebes must consume approximately 13,000 shrimp per day to support their migration from GSL (Dr. Michael Conover, personal communication), thus a potential selenium toxic endpoint is inadequate build up of mass for migration. In other avian species, e.g. mallards, the level of selenium required to impair adult health is higher than that required to impair reproduction (Dr. Joseph Skorupa, personal communication), suggesting focus on the toxic endpoints associated with reproduction.

Avocets/stilts and northern shovelers were chosen to represent species that breed on GSL. Their diet contains a high concentration of brine flies, brine shrimp, or corixids, making them more at-risk than other over-wintering birds from selenium toxicity. Furthermore, sufficient numbers of eggs can be easily obtained for these species, and in the case of avocets/stilts their foraging area restricted to relatively short distances. A disadvantage of avocets is their relatively low sensitivity to Se. An advantage of Shovelers is that toxicity data from Mallards may be transferable.

### Momentum

The conceptual model illustrates the critical pathway of selenium from water, to microorganisms, to brine shrimp and brine flies, to birds, and to their eggs. Surveys of selenium concentrations within these "stocks" will yield bio-concentration factors for selenium between these "stocks" and will thereby support the back-calculation of an open water standard. An interim standard could be developed over the course of a single year. However, the confidence in this standard would be enhanced by surveys performed over multiple years to account for year-to-year variation in the Great Salt Lake system. Additional surveys are needed to determine selenium loads to the system in a fashion that accounts for year-to-year variation. Furthermore, selenium particulate fluxes into and out of sediment, and selenium vapor fluxes upward through (and exiting) the system, need to be examined. 🐼

William P. Johnson, Ph.D,  
Assoc. Professor Geology and Geophysics, U of U



# RICH HANSEN

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## WORK IS ALWAYS A PLEASURE...



*Rich and friend by Yae Bryner*

Rich Hansen, the new manager of Farmington Bay, is no stranger to the Great Salt Lake wetlands. Prior to taking over last April, he worked as an assistant to Justin Dolling, Farmington's longtime manager and as an assistant manager at Ogden Bay. In addition, he spent four summers doing seasonal work at Ogden Bay, which gave him experience in managing waterfowl, water levels, wildlife, and wetland vegetation.

Rich grew up on a farm in Weber County. Working on the farm gave him an abiding love of the outdoors. John Kimball, former UDWR director, told a teenage Rich that if you select something you loved to do as a profession; going to work would always be a pleasure. The advice stuck with him and he went on to receive his degree in wildlife man-

agement from Utah State University. While studying he spent 5 months in Alaska working on wildlife issues in Anchorage, the Pribilofs, and Barrow.

The job has its challenges, phragmite control or the growing predator population, but for a guy who loves the outdoors and the GSL wetlands, managing Farmington Bay is a near perfect job. What could be better than skimming the water on an airboat at dusk or dawn surrounded by thousands of birds? 🦆

Yae Bryner

Utah linking partner, educator and volunteer extraordinaire



*Eagle* by Gary Crandall



# LAKESIDE LEARNING

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## GREAT SALT LAKE FIELD TRIPS



Great Salt Lake Field Trips are now available to 4th grade students & teachers.

FRIENDS of Great Salt Lake has just received generous support from the Richard K. and Shirley S. Hemingway Foundation to fund our Lakeside Learning program out at Antelope Island State Park this Spring.

Our educational field trips to Great Salt Lake include aquatic and shoreline activities. They consist of a combination of full-group gatherings for introductions, discussion or review, and a variety of small team assignments. This experience is intended to complement prior and follow-up Great Salt Lake classroom studies so students can benefit from a complete learning experience. The web of life at and around Great Salt Lake is an extraordinary example of our planet's rich network of relationships between land, water, food and survival. Our place-based approach to education provides an exceptional opportunity to explore biology, chemistry, geography, geology, weather and history--all on a global scale. Lakeside Learning is one of the most important parts of our Project SLICE, a comprehensive standards-based 4th grade science curriculum developed by FRIENDS.

A \$360 fee is normally charged to cover field instruction, entry fees, equipment and supplies. However, upon approval of a scholarship application FRIENDS of Great Salt Lake will provide these services to qualifying classrooms for a \$1 per student administration fee. Transportation costs remain the responsibility of the school. Multiple classrooms from one school may apply, but the total number of students cannot exceed 80. Scholarships are highly competitive and preference will be given to teachers having attended a SLICE workshop and groups who have not previously attended a Lakeside Learning field trip. On-site time is limited to 2.5 and 3.5 hours.

You may obtain more detailed information and download an application from our website at [www.fogsl.org](http://www.fogsl.org). Details pertaining to adult chaperones, field trip schedule, pre- and post-trip activities and other preparations will be provided following application approval.

This is also an excellent opportunity to volunteer. Your FRIENDS needs YOU to help staff and administer this program. If you like kids and enjoy being out at the Lake, join us and become a Lakeside Learning facilitator. After a short training period you can become qualified to co-facilitate our Lakeside Learning field trips. Volunteers must commit to at least 3 field trips. Each field trip lasts about 5 hours, including travel time to Antelope Island State Park. Call Katie at 801-322-3216 for more information.



# A SLICE OF SLICE



## White Pelican

Illustration from *Birds of the Rocky Mountain* by Chris C. Fisher. © 1997 Lone Pine Publishing, Edmonton, Alberta, Canada. Reprinted with permission.

A product of Project SLICE: The Friends of Great Salt Lake Initiative for Conservation Education  
Produced in collaboration with EcoTracs, Salt Lake City, Utah 801/467-3240 ecotracs@aol.com © Friends of Great Salt Lake revised 09/18/01

### The American White Pelican

**Breeding range:** mainly on isolated island in freshwater lakes, forages on inland marshes, lakes, or rivers, favoring shallows. Breeding island commonly 50 km+ from foraging areas, up to 100 or so "airline" miles; wintering range: southern and western coastal marine habitats, rarely inland.

**Food:** mainly small fish of little commercial value. At GSL, diet: 65.9% minnows, 20.2% carp, 10.1% chub, 3.8% suckers. Eat 1.8 kg/day, 20-40% of body mass.

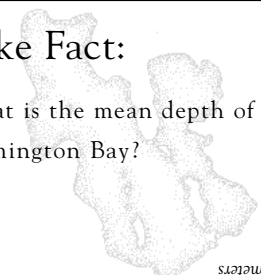
**Nesting:** is colonial, on bare, low-lying islands free of mammalian predation, nest scrape either lined with pebbles and debris or is completely unlined.

#### Best places and times to see them at GSL:

Cutler Marsh, Bear River Migratory Bird Refuge, Willard Bay State Park. A large population breeds on Gunnison Island. From Gunnison Island fishing parties visit the Bear River National Migratory Bird Refuge 35 miles away, and some pelicans fly as far as 90 miles to Utah Lake, a former nesting site, to obtain food. Can be seen at GSL from spring to summer.

#### Lake Fact:

What is the mean depth of Farmington Bay?



Answer: 0.9 meters



# DOYLE W. STEPHENS RESEARCH SCHOLARSHIP

## Celebrate the Legacy

### **Purpose:**

The Doyle W. Stephens Scholarship, sponsored by the Friends of Great Salt Lake (FoGSL), celebrates Doyle's scientific contributions toward understanding the Great Salt Lake Ecosystem. This scholarship provides support to undergraduate and graduate students engaged in new or on-going research that focuses on the Great Salt Lake and its surrounding ecosystem. The award may be used to support laboratory or field research, attendance at professional meetings, or other activities that further the understanding or protection of the Great Salt Lake Ecosystem. Research located anywhere in the Great Salt Lake watershed can qualify for this award.

### **Qualifications:**

Applicants must be undergraduate or graduate students currently enrolled at an accredited college or university. Specific application details are available at <http://www.fogsl.org/research/doylestephens.html>.

### **Selection of Award Recipients:**

For the year 2006 one award of \$500.00 will be given. Applications will be judged on the following criteria: 1) Probability of successful completion of the proposed research (based on transcripts, letter of support, and feasibility of project), and 2) Potential contribution of the proposed research to the protection, preservation or understanding of Great Salt Lake Ecosystem.

### **Scholarship Recipient Requirements:**

We request that the recipient present their research findings to the FoGSL membership. This can occur as a presentation at a general membership meeting and/or as an article in our quarterly newsletter.

### **APPLICATION DEADLINE:**

March 15, 2006 - AWARD RECIPIENT WILL BE ANNOUNCED on MAY 5, 2006 at the FoGSL Biennial Great Salt Lake Issues Forum.

**For a copy of the application or more information, please visit [www.fogsl.org](http://www.fogsl.org) or contact the FRIENDS of Great Salt Lake information line (801) 583-5593**







## DR. EPHYDRA - WE WELCOME YOUR QUESTIONS VIA EMAIL OR PHONE

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

Brought to you by the Science Committee to help explain the science surrounding Great Salt Lake. We welcome your questions via email or phone. Contact Amy Marcarelli at [amym@cc.usu.edu](mailto:amym@cc.usu.edu)

### Continentality and Great Salt Lake's Influence on Local Temperatures

Continentality is a climatological term referring to how much or how little a place's climate is influenced by large bodies of water. Oceans and big lakes soak up heat in summer and release it in winter, so coastal (or 'marine') locations typically have cooler summers and warmer winters than continental locations. Not surprisingly, the State of Utah has a strongly continental climate.

In northern Utah, however, the Great Salt Lake works to bring a small coastal influence to the climate. The lake is shallow, so the total volume of water—and therefore the total heat storage—is quite small compared with the Great Lakes, for example. However, water can 'store' more energy the saltier it gets, so the hypersaline waters of the Great Salt Lake make excellent storage heaters. As a result, locations near the lake shore can have warmer winters than locations far from the lake, an effect which can easily be seen in maps of temperature to be found in most atlases.

Unlike most other bodies of water, however, the Great Salt Lake shows tremendous variability in the water level: a range of some 20 feet has been recorded between the record low levels in 1963 and the record high levels in the 1980s. This variability in lake level could mean that

the lake's influence on climate also varies. A smaller lake might be expected to result in colder winters and hotter summers than a larger lake. This effect is difficult to detect, because many things besides the lake can influence whether a winter is particularly cold or warm, such as El Niño currents in the Pacific Ocean. Research currently under way at Weber State University, however, is showing promising initial results. By comparing temperatures at lakeside places with temperatures at places far from the lake, other influences on climate are accounted for and the lake's effect on temperature becomes apparent, with differences between the lake and non-lake locations presumably being due to local conditions, notably, the Great Salt Lake. If these initial results are accurate, it could be that a 4.5-foot drop in lake level produces a 1 °F drop in winter temperatures in Salt Lake City. This could be one more good reason to be concerned about ecosystem-scale management of the Great Salt Lake. 🐦

#### References:

D.C. Greer, K.D. Gurgel, W.L. Wahlquist, H.A. Christy and G.B. Peterson (eds.), 1981, *Atlas of Utah*. Provo, Utah: Brigham Young University Press.



*Bear River Community* by Rosalie Winard



# DISCOVERING OUR LAKE

## The Eagles of Farmington Bay

As you are likely aware, Farmington Bay (the Bay), annually hosts a large, wintering bald eagle population. From, roughly, November through March, bald eagles soar, roost, preen, loaf, hunt and scavenge to survive bitterly cold temperatures, ice, snow and sleet. While waterfowl and even deer and ranch/farm animals sustain bald eagles during the winter, at Farmington Bay the annual control of carp is a major factor in drawing the species to the site.

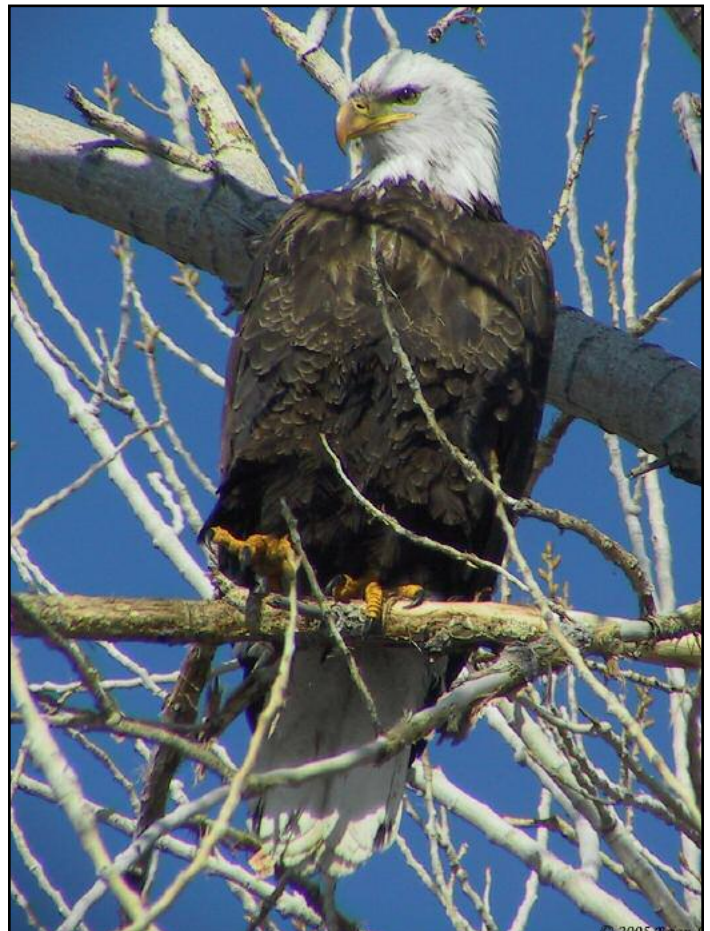
Bald eagle numbers at the Bay vacillate to include birds that winter entirely within the greater Great Salt Lake area, birds that pass through on their way to areas further to the south and those that accumulate, or stage at Farmington Bay before the spring migration to the north. It is not uncommon to see a few, or even 20 to 25 bald eagles in the area of the small row of black willow snags on the way toward Goose Egg Island and in groves of trees to the north and west of Farmington Bay Waterfowl Management Area headquarters and maintenance facilities. Elsewhere, in almost any direction from the dike roadway system, bald eagles can be spotted loafing, or foraging on the ice in proximity to nearby, open water, perched on almost any snag, or high spot, and flying solo, or in groups of two, or three individuals. In recent years, during February and early March, bald eagle numbers have mushroomed as evidenced by bird watcher tallies of 250 to 300 birds. Upon seeing such a large gathering of bald eagles in one place at one time, most visitors to Farmington Bay are both exhilarated and grateful for a most memorable outing among the eagles!

Over the last ten, or fifteen years, Farmington Bay has served as one of five, or six sites throughout Utah where the public can enjoy watching and learning about bald eagles by attending the annual Utah Bald Eagle Day celebration. This year, Bald Eagle Day will be celebrated at Farmington Bay (and Salt Creek Waterfowl Management Area to the north) on February 11 from 9:00 a.m. to 4:00 p.m. Viewing Tips: (1) To say the least, foggy days make watching eagles frustrating! Wait for clearing skies, to maximize your eagle watching experience. (2) Don't neglect to watch overhead: the human tendency is to look straight ahead and side-to-side only. Look up and out over the water and up toward the mountains to glimpse eagles out on reconnaissance flight(s), locking talons in pre-nesting season pair bonding maneuvers, or soaring to high elevation roosts. (3) Put in the time to

watch for interactions between eagles, particularly when two, or more are on the ground/ice vying for the same morsel of food. Eagle antics at the dinner table can be as fun to watch as your children, or your pet(s), or your memory of same when it comes to food.

Farmington Bay is open year round from 8:00 a.m. to 5:00 p.m. seven days a week at the main entrance southwest of Farmington at 1325 W. Glover Lane (925 S.). The main headquarters (north entrance) is accessed via Glover Lane near Farmington. Exit I-15 at Center-ville (exit # 319), proceed north on east Frontage Road to Glover Lane. Travel west on Glover Lane to 1325 West. Turn south and drive .5 mile to headquarters. 🗺️

Bob Walters  
Watchable Wildlife Program Coordinator  
Division of Wildlife Resources



*Eagle at Farmington Bay by B. Currie*





*Eagle with Fish* by B. Currie



*Eagle in Flight* by B. Currie





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## GREAT SALT LAKE PEOPLE

**Peter Behrens (1927-2005)**, founder of Great Salt Lake Minerals and Chemicals Corp., creator of the Behren's Trench in Gunnison Bay of Great Salt Lake; respected scientist and engineer, died in the winter of 2005, at the age of 78.

**Congratulations to Dr. Maunsel Pearce**, Chair of the Great Salt Lake Alliance, for being awarded the William Olwell Conservation Award for 2005.

WE want to thank **Matt Crawley Design**,

**The Tooele Transcript Bulletin and Xmission.com.**

## SUBMITTING MATERIAL FOR PUBLICATION

**Deadlines:** Sept. 16 (Fall), Dec. 16 (Winter), Mar. 16 (Spring), and June 16 (Summer). Submit articles and images for consideration to **Lynn de Freitas** [ldefreitas@earthlink.net](mailto:ldefreitas@earthlink.net) or call 801-583-5593.

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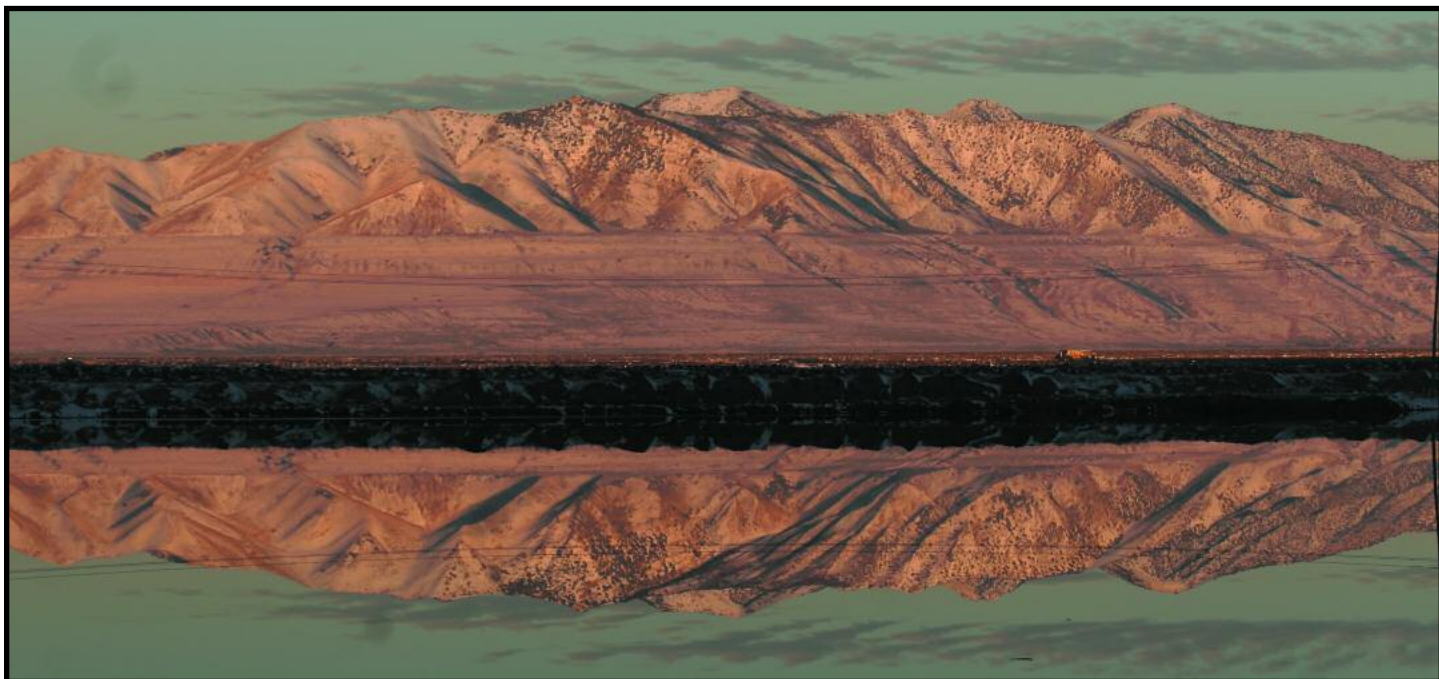
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View from Great Salt Lake Minerals by R. Moseley