Joint Conference

10th International Conference on Salt Lake Research &

2008 FRIENDS of Great Salt Lake Issues Forum

Saline Lakes Around the World: Unique Systems with Unique Values

University of Utah, Salt Lake City, Utah
May 11-16, 2008

International Society for Salt Lake Research (ISSLR)
and FRIENDS of Great Salt Lake present the joint

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PROGRAM AND ABSTRACTS

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ABSTRACTS

THREATENED ARTEMIA BIODIVERSITY IN THE IBERIAN AND WESTERN MEDITERRANEAN REGION

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There is a certain variety of deterministic factors, usually associated to anthropic activities, leading to the biodiversity loss in many species. Two of the most important among these factors are the loss of appropriate habitats for the development of their populations and the introduction of exotic invasive species. The autochthonous species of the genus *Artemia* are being eliminated from hypersaline ecosystems in the Old World after the introduction of *A. franciscana* from America. This report summarizes some data about a) the present distribution of autochthonous *Artemia* populations, together with the invasive *A. franciscana* populations identified, in the Iberian and Western Mediterranean area, b) some fitness traits, obtained from experimental populations kept in standard culture conditions, useful to assess the biological efficiency of these species, and c) the implications of these traits on the competitive elimination of autochthonous species by the invasive one in an open air microcosm system. Among these fitness traits the prereproductive and between brood periods, together with the offspring output quality per female and per day, provide *A. franciscana* a superior performance enough to trigger an efficient competitive mechanism. [Session 14]

AVIAN USE OF A CONSTRUCTED SALINE WETLAND COMPLEX AT THE SALTON SEA, CALIFORNIA

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Constructed, saline wetlands are currently being considered as a major component of wildlife habitat restoration for the Salton Sea in southeastern California, USA. The concept utilizes a mixture of hypersaline Salton Sea water and agricultural runoff to create a series of impoundments with salinities ranging from 20,000 mg/l to 200,000 mg/l. A 50 hectare site with four ponds is being evaluated to assess the suitability of this concept for migratory birds. The results will be provided to restoration program managers. Beginning in 2006, bird use was monitored at the saline habitat ponds (SHP) and three reference sites at the Salton Sea. Bird densities differed from the SHP by +37%, -31%, and +320% while species diversity among habitats was similar. Over the first two seasons, nesting success was 59% for Black-necked Stilt (*Himantopus mexicanus*) and 66% for American Avocet (*Recurvirostra americana*). Nest depredation and flooding were identified as major factors contributing to the failure of nests on levees and mudflats but not on islands. [Session 3]

MONITORING BIDIRECTIONAL DENSITY DRIVEN FLOW IN GREAT SALT LAKE, UTAH

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Great Salt Lake (GSL) is bisected by a causeway that creates a large salinity difference between the southern part of the lake, which receives most of the surface runoff from the surrounding mountains, and the northern part of the lake. Underflow of higher salinity, and therefore more-dense water from the northern part of GSL creates a deep brine layer (DBL) under the less saline, and therefore less-dense water of the southern part of the lake. Both bottom-mounted and floating acoustic Doppler profilers have been deployed in the lake to determine flow velocities and direction. The bottom-mounted instrument also provides information on the existence and relative “strength” of the interface gradient between the DBL and the upper brine layer (UBL) and what happens to this interface during wind events. Signal to noise ratios and vertical velocity data are also used to determine periods of lake bottom sediment resuspension. These data are used to develop a better understanding of the hydrologic processes controlling mercury cycling in GSL. [Session 13]

IS THERE A BIENNIAL FLUCTUATION OF PHYTOPLANKTON BIOMASS IN THE TROPICAL, SALINE LAKE ALCHICHICA?

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Saline Lake Alchichica displays a regular annual phytoplankton biomass pattern associated with the lake's hydrodynamics (warm monomixis). The pattern comprises a winter circulation diatom bloom, an early stratification cyanobacteria bloom, and a deep chlorophyll maximum (DCM) along the stratification period. Spatially, phytoplankton biomass production moves from the mixed layer during circulation and early stratification to the metalimnion during the well-established and late stratification. A four-year (2003-2006) study confirmed the annual pattern regularity but also showed large inter-annual differences in phytoplankton biomass during the winter circulation bloom, suggesting a biennial cycle. By analyzing phytoplankton biomass anomalies as chlorophyll "a", it was clear odd years were less productive (2003 = +63 & 2005 = +107 mg m-2) and long lasting (1 month) than even years, which were more productive (2004 = +637 & 2006 = +431 mg m-2) and the bloom lasted longer (3 months). Earlier and stronger hypolimnetic anoxia in the more productive years indicates phytoplankton are rapidly exported to the bottom. However, we did not found equivalent chlorophyll "a" concentration pattern in the sediments. [Poster]

RESOURCE ASSESSMENT OF ARTEMIA (CRUSTACEA: ANOSTRACA) IN THE URMIA LAKE IN RAINY (1995) AND DROUGHT (2003) YEARS

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Urmia Lake is the largest *Artemia* habitat in the world. From 1995 to 2003 its average salinity increased from 169 ppt in 1995 to 275 ppt. There are two invaluable studies on *Artemia* resources in Urmia Lake; 1995 (rainy year) and 2003 (drought year). The average production of *Artemia* cysts was almost 4400 ton/year in 1995 within the top 0.5-meter of the entire Urmia lake; also there was 29 cysts/liter in top 0.5 meter of the entire lake during 2003. The data from these two studies are incommensurable. With satellite imagery, we determined the area of Urmia Lake in November 2003 to be 4304 km^2 so data from the two studies could be compared. Our calculations indicate 4400-ton cyst produced in 1995 is equivalent to 399 cysts/liter and the 29 cysts/liter measured in 2003 to be equal to 250 ton cyst in the top 0.5 meter of entire lake. Thus, *Artemia urmiana* cyst production per liter has decreased 14-fold from 1995 to 2003 while the total resource has decreased by 18 times as much. [Session 14]

AVIAN RESPONSE TO EARLY TIDAL SALT MARSH RESTORATION AT FORMER COMMERCIAL SALT EVAPORATION PONDS IN SAN FRANCISCO BAY, CALIFORNIA, USA

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Restoration of former commercial salt evaporation ponds in the San Francisco Bay estuary is intended to reverse a severe decline (>80%) in tidal salt marshes. San Francisco Bay is a critical migratory stopover site and wintering area for shorebirds and waterfowl, and salt ponds are important high tide roosting and foraging areas. Conservation of past bird abundance is a stated goal of area restoration projects, and early adaptive management will be critical for achieving this objective. However, initial avian response at sites restored to tidal flow may not be indicative of long-term results. For example, winter shorebirds at a 529-ha pond breached in 2002 showed a marked increase in shorebird abundance following breaching. Shorebirds comprised 1% of area totals during 1999-2002 and increased to 47% during 2003-2007. These changes accompanied increased tidal range and sedimentation, but minimal vegetation establishment. Conversely, a fully-restored 216-ha pond in the same system supported less than 1% of all waterbirds in the region. Early restoration may temporarily increase habitat, but managed ponds will be needed for long-term waterbird abundance within a restored pond system. [Session 10]

SHOREZONE LANDFORMS OF SHALLOW CLOSED-BASIN LAKES, EVIDENCE OF STORM-WIND STRENGTH AND DIRECTION

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Shorelines and sediments of shallow closed-basin lakes record lake fluctuations and document lake processes. A detailed study of elevations of shoreline debris of Great Salt Lake provides evidence on how the lake responds to winds blowing across it. Specifically, shoreline superelevation, the difference in elevation between still-water lake level and shoreline evidence, documents relative energy of on-shore waves. Shoreline elevation was documented for well-exposed, nearly continuous shoreline expressions created during the 1986/87 highstand fluctuation of Great Salt Lake. Higher shoreline superelevation along shores of Great Salt Lake is associated with longer fetch, shores that face west and northwest into the direction of strongest storm winds, steeper shorezone slope, and erosional coastal landforms. For lake levels of 1986/87, wind strength was more important than fetch in determining highest shoreline superelevation. The contribution of wind strength to superelevation is explained by Great Salt Lake's fetch-limited size, with wave-generating areas sufficiently small that wave environments do not develop into fully arisen seas. [Session 13]

MAGNETOTACTIC BACTERIA FROM THE SALINE ALKALINE LONAR LAKE, INDIA

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Lonar Lake is a saline alkaline lake formed in a meteorite impact crater located in the Buldhana district (Lat. 190 58' North, Long. 760 34' East) of the west-central state of Maharashtra, India. Earlier reports of the presence of titaniferous magnetite crystals in heavily shocked impact glass in the crater and our own detection of magnetic activity in the surrounding rocks and soil led us to look for magnetotactic bacteria in the ecosystem. Preliminary screening studies using the 'capillary race-track method' after in situ enrichment on a few samples of littoral soil and sediments collected from around the lake yielded four magnetotactic bacterial isolates. All the isolates showed the typical 'precise alignment' at the edge of a hanging drop and the 'magnetic south seeking' tactic behavior. Morphologically, two were gram positive rods, one a gram negative short rod and the fourth, a gram positive coccus. Their intracellular iron content as determined by atomic absorption spectroscopic analysis showed increases between 5.0- to 11.6-fold over that of the nonmagnetic culture. [Poster]

ESTIMATING THE GLOBAL EXTENT OF ENDORHEIC BASINS, TERMINAL LAKES AND SALINE LAKES: AN EXPERIMENTAL APPLICATION TO AFRICA

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Accurate global-scale estimates of the areal extent of saline lakes are important for research including work on greenhouse gas fluxes, biodiversity conversation, and comparative lake basin management. Commonly cited estimates such as Kalanin and Bykov (1969), Shikolmanov (1990, 1998) and Williams (1996) unfortunately do not clearly describe methods and sources nor are they in digital form. Furthermore, many well-known but relatively small saline lake regions do not seem to be included, indicating that the global extent of saline lakes may be underestimated. As the next step toward a more accurate global estimate, we use a high-resolution 30 arc-second digital elevation model (SRTM) in a geographic information system to delineate endorheic regions of Africa. This is approximately an order of magnitude finer than the HYRDO1K dataset and allows us to capture smaller endorheic areas. The SRTM Water Body Dataset (SWBD) is used to identify which endorheic basins contain terminal lakes. The WORLDCLIM database is used to predict aridity and to infer salinity. Anecdotal evidence and groundtruthing provide further confirmation. The same methods are being applied to the other six continents. [Session 2]

THE IMPACT OF ENVIRONMENTAL CHANGE AND INDUSTRIALIZATION ON LAKE KATWE IN SOUTH WESTERN UGANDA: IMPLICATIONS TO THE LIVELIHOODS OF THE LOCAL COMMUNITIES

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Lake Katwe, in the Albertine region, is the largest salt lake in Uganda and an important ecosystem to the livelihoods of the local communities. The lake and its catchment form a major environmental and economic base for the region through tourism and mining. The long-term eco-sustainability of Lake Katwe is threatened by environmental changes and increased industrialization. Linked to Mt. Rwenzori through numerous streams, Lake Katwe has been affected by environmental change, which also accounts for 20% reduction in glaciers on Mt. Rwenzori. The Lake Katwe region has developed as an industrial zone due to the enormous mineral potential, particularly copper, cobalt, cement and salt. However, a time series analysis of the water chemistry in the lake and surrounding streams shows increasing concentration of heavy metals, especially copper, zinc, iron, manganese and sulphate; which are heavily linked to pollution from industries. This pollution, coupled with the threat of environmental change, will have a significant impact on the livelihoods of the indigenous inhabitants who depend upon the continued vitality of the lake and its environment. [Poster]

SALTY SECRETS OF ANCIENT BRINE: CELLULOSE ENCASED IN 250 MA PERMIAN HALITE

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In this study we used transmission electron microscopy to examine the contents of fluid inclusions in halite (NaCl) and solid halite crystals collected 650 m below the surface from the late Permian Salado Formation in southeastern New Mexico (USA). The halite has been isolated from contaminating groundwater since deposition approximately 250 Ma ago. We show that abundant cellulose microfibers are present in the halite and appear remarkably intact. These cellulose microfibers represent the oldest native biological macromolecules to have been directly isolated, examined biochemically, and visualized (without growth or replication) to date. This discovery points to cellulose as an ideal macromolecular target in the search for life on other planets in our solar system. [Session 1]

SELENIUM AND TRACE ELEMENT MOBILITY AFFECTED BY PERIODIC INTERRUPTION OF MEROMIXIS IN THE GREAT SALT LAKE, UTAH

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Movement of selenium and other trace metals present in the lake bed sediments of Great Salt Lake (GSL) may occur due to periodic mixing events or lake area decrease. The water column of the GSL is complicated by the presence of a chemocline that is persistent over annual to decadal time periods. The water below the chemocline (deep brine layer) has a high salinity (22 %) and is anoxic. The water above the chemocline has lower salinity (14 %) and is oxic. Evidence of mixing in the water column has been observed at two fixed stations on the lake using detailed temperature profiling and hydroacoustics. The deep brine layer responds to changes in the lake surface area and may cause a change in oxidation state in bed sediments over a period of months. Laboratory simulations of observed sediment resuspension indicate that a small percentage of selenium (1.16 %) associated with anoxic bottom sediments is periodically recycled into the upper brine layer where it can potentially be incorporated into the biota utilizing the oxic part of GSL. [Session 8]

EFFECT OF MERCURY ON THE BRINE SHRIMP ARTEMIA FROM THE GREAT SALT LAKE

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Mercury, a toxic metal accumulating in the Great Salt Lake, has been found in high levels in shrimp and bird tissues. We investigated the effect of mercury on various brine shrimp life cycle and biochemical parameters. Larvae and adult survival were tested after 24-hour acute exposure in mercury concentrations ranging from one gram to one microgram per liter. Survival, maturation time, number of eggs per brood and type of brood were observed in shrimp raised in mercury concentrations ranging from one milligram to one microgram per liter. SDS-PAGE on shrimp tissue showed the protein profile under mercury stress. Mortality levels increased sharply from 0 to 50% in adult and larvae exposed to mercury concentrations increasing from 1 to 10 mg/l. Survival rates were minimally affected in shrimp raised at 1 mg/l mercury. However, maturation time increased while the number of eggs per broods decreased in shrimp raised at 0.1 mg/l mercury. No significant effect was demonstrated in shrimp raised in 0.1 µg/l mercury. Protein profiles suggest that some proteins are down-regulated while others are up-regulated. [Poster]

BATHYMETRIC MAPS AND DIMENSIONLESS DEPTHS OF SOME MAJOR LAKES IN NEPAL

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The exact number of lakes in Nepal has not yet been identified. However, a preliminary inventory reveals that 65 percent of lakes can be classified as small with surface area less than 5 hectares. Approximately 5 percent have surface areas greater than 50 hectares. This paper discusses the physiographic data of some major lakes, specifically bathymetric parameters of Tilicho Lake at 5000 meter altitude, Rara Lake at 3000 meter altitude, Mai-Pokhari at 2100 meter altitude, and Ghodaghodi Lake at 170 meter altitude. The water of Rara Lake is unpolluted whereas water bodies located within urban areas are extremely polluted. The dimensionless depth of a lake, defined as the ratio between cubic root of lake volume and square root of lake area, is greater than 0.25 in mountainous regions and less than 0.2 in Tarai plains. The dimensionless depth can be used to estimate total volume of water of similarly classified lakes. The total volume of water stored in 700 significant lakes of Nepal is estimated to be about 2.5 billion cubic meters. [Poster]

THE USE OF REMOTE SENSING TO TRACK PHYTOPLANKTON DISTRIBUTION IN THE GREAT SALT LAKE, UTAH, USA

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One of the main basins of the Great Salt Lake (GSL), Farmington Bay, is highly eutrophic due to wastewater treatment plant discharges. NASA's MODIS satellite imagery shows blooms of cyanobacteria in Farmington Bay that stretch up to 20 km into the main lake (Gilbert Bay). A GSL-specific chlorophyll algorithm was developed with 53 samples from three 2006 synoptic surveys. Monthly chlorophyll samples provided 26 validation points from May- December. The algorithm exhibited a good fit for extracted chlorophyll values (r-squared = 0.84). The imagery and algorithm demonstrated up to 5-fold spatial differences in chlorophyll in Gilbert Bay on a single date, and rapid changes of up to 10-fold in chlorophyll levels within 1-week. Shortcomings included failure at chlorophyll >35 µg/L, lack of useable satellite imagery from Jan-March and spatial resolution issues in Farmington Bay. Although additional development would be useful, our current technique using MODIS imagery provides a very useful tool for research and management of the Great Salt Lake. [Session 6]

RELATIONS OF TRACE METALS IN SURFACE SALTS TO THE UNDERLYING GROUND WATER OF FRANKLIN LAKE PLAYA AND THE ASH MEADOWS AREA OF NEVADA AND CALIFORNIA

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Saline ground water and surface salts in the Franklin Lake Playa area contain large concentrations of trace elements. Dissolved concentrations range as high as 36 mg/l arsenic, 43 mg/l molybdenum, 1.8 mg/l selenium, 0.7 mg/l tungsten, and 10 mg/l uranium. These metal enrichments can be explained largely by evaporative concentration of dilute (<1 mS/cm), shallow ground water (<2 m) with two possible sources of dissolved salt input as suggested by sulfur isotope data. Evaporation of spring discharge in the Ash Meadows area and along the Carson Slough connecting drainage forms carbonate, chloride, and sulfate salts that accumulate arsenic and other trace elements in proportion to their content in the water. Water-soluble salts on the ground surface in Ash Meadows and upper Carson Slough contain metal concentrations as high as 600 ppm arsenic, 140 ppm molybdenum, 4 ppm selenium, 11 ppm tungsten, and 50 ppm uranium. Salts on the playa surface have trace metal contents lower than those from the inflow areas suggesting physical or chemical fractionation. The metal-rich salts become entrained in wind-blown dust that is dispersed over broad areas. [Session 5]

REGULATION OF SELENIUM FLOW THROUGH FOOD WEBS: LIMITS TO UPTAKE BY PHYTOPLANKTON AND THEIR BRINE SHRIMP GRAZERS

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The Great Salt Lake (GSL) is an important staging and breeding area for millions of waterfowl that feed on its abundant brine shrimp (*Artemia franciscana*). Brine shrimp are unaffected by selenium (Se) concentrations that cause teratogenesis in avifauna. A conservative avian dietary threshold is 5 mg Se kg-1 dry weight (dw) of brine shrimp. Recognizing the unique GSL chemistry, we conducted laboratory tests of selenium accumulation by indigenous algae (*Dunaliella viridis*) and brine shrimp in GSL waters. Both species were exposed to aqueous selenium for 12 to 60 days (algae) or 10 to 40 days (15 day old shrimp). In addition, shrimp received dietary selenium. Selenium concentrations were approximately 2, 10, 27 µg L-1 with exploration of higher concentrations (<208 µg L-1). Algae bioaccumulated <3 mg/kg dw. For Se concentrations <48 ppb, regardless of exposure pathway shrimp accumulations were <4.3 mg/kg dw (< avian threshold), and were uncorrelated with Se concentrations. These findings and in situ measures of aqueous Se and tissue concentrations in GSL shrimp, indicate that brine shrimp regulate this essential nutrient in Great Salt Lake waters. [Session 8]

MANAGING SALT LAKES IN THE NEOTROPICS: CHALLENGES AND ALTERNATIVES - THE CASE OF MAR CHIQUITA, ARGENTINA

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The vast Mar Chiquita Ramsar site includes a terminal salt lake and associated grasslands and wetlands located in central Argentina. The area is very rich in biodiversity, particularly with continental migratory shorebirds and flamingos. Even if still largely pristine, the area is becoming increasingly threatened by human-induced environmental problems. Main threats include a) water appropriation in the upper tributary rivers, b) increasing water pollution, and c) increasing sport hunting pressure from international bird-hunting tourism. Moreover, a decrease in water availability may result in changes in the annual flooding and fire regime, which could have profound effects on grasslands and wetlands that surround the lake. Climate change is also affecting the area. Between 1970 and 2000 the regional rainfall regime increased about 30%, which resulted in a nine meter rise of the lake's water level, together with a substantial expansion of the agricultural frontier. A long-term conservation effort being implemented by an association between the University of Cordoba and local NGOs is described. [Session 12]

RECOVERY OF THE THREATENED LAHONTAN CUTTHROAT TROUT IN A DESERT TERMINAL LAKE

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Walker Lake is the terminus of the Walker River watershed and southernmost arm of the Pleistocene Lake Lahontan. Due primarily to upstream diversion, Walker Lake volume has declined considerably, resulting in a current total dissolved solid measurement of approximately 16,000 mg/l. Lacustrine populations of Lahontan cutthroat trout (LCT), native to Walker Lake, have been extirpated from most of their lake habitats. To improve our understanding of the fishery, we have been conducting research to determine LCT survival, population abundance and distribution, and refinement of stocking techniques to increase immediate stocking survival. Netting and creel survey efforts indicate that some post-stocking survival is occurring and that the average growth rate is 18 millimeters per month for stocked fish. The most effective means of improving stocking survival is allowing LCT to self-acclimate to the high TDS in Walker Lake by stocking them in the river/lake confluence. The primary goal of this effort is to improve LCT survival in Walker Lake and study the lake ecosystemís response to changing TDS levels. [Session 14]

RESTORING THE WATER QUALITY OF THE SALTON SEA, CALIFORNIA: CHALLENGES IN ESTIMATING RISKS FROM SELENIUM AND EUTROPHICATION

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The State of California has evaluated alternatives for the enhancement of water quality and habitats that will restore the diversity and abundance of fish and wildlife of the Salton Sea. This terminal, saline lake is the largest lake in California and has undergone significant change in recent years from degraded water quality, increasing salinity, and evaporative drawdown. Historically excellent marine fisheries and major over wintering use by migratory waterfowl are threatened by increasing levels of salinity, eutrophication, and elevated levels of selenium in the system. Several specific restoration alternatives that would create or enhance marine, estuarine, freshwater, and terrestrial habitats were investigated. Each alternative was evaluated for effectiveness through an ecological risk assessment process for selenium. In addition, the lake is hyper-eutrophic and water quality concerns have focused on the maintenance and enhancement of wind mixing, with special emphasis on the problems of oxygen depletion and hydrogen sulfide formation in planned aquatic habitats. Restoration alternatives were ranked and compared based on differences in selenium exposure and risk and on potential water quality problems associated with eutrophication. [Session 3]

AUTOMATED RIBOTYPING OF HALOPHILIC BACTERIA ISOLATED FROM DIFFERENT HYPERSALINE ENVIRONMENTS IN TURKEY

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The RiboPrinter® microbial characterization system provides the speed, accuracy and resolution needed to identify bacteria and then compare them at the strain level for efficient and consistent characterization. In this study, selective isolations of halophilic prokaryotes were carried out by using sea water agar. Bacterial strains were selected by using bacteria-specific 16S universal primers. A total of 23 halophilic strains isolated from different habitats (salterns, salt lakes and salt rock) were analyzed by using the RiboPrinter® microbial characterization system with EcoRI enzyme. Chromohalobacter salexigens was used as positive control and all of the strains gave ribotyping pattern. The results showed that a ribotyping library of halophilic bacteria can be evaluated. [Poster]

THE ROLE OF NGOS IN THE CONSERVATION AND MANAGEMENT OF SALTSCAPES IN SPAIN. THE CASE OF THE ASSOCIATION OF FRIENDS OF INLAND SALINAS

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Saltscapes need a keen eye to be appreciated, as they do not offer instant, pleasant experiences. This is an important challenge for most NGOs devoted to their protection and dissemination. There are two main types of organizations that deal with saltscapes in Spain: nature conservation and cultural heritage associations. In the first case, the interest is nature conservation in general and may involve different levels. In the second case, the interest is local cultural heritage and may include (historic) salt making sites. Only a few cultural associations are centered in the local salt making heritage. These act at a local level and often ignore each other's existence. In 2002, the Association of Friends of Inland Salinas (ACASI) was born with the aims of preserving, studying and disseminating the cultural and natural values of saltscapes. In Spain, it is the only organization specialized in salt heritage in general that acts at national and international levels, offers technical assistance and consultancy on salt issues, and functions as a network for people and institutions related to salt heritage. [Session 12]

BREEDING PRODUCTIVITY OF WATERBIRDS AT GREAT SALT LAKE: THE EFFECTS OF PREDATORS AND LAND MANAGEMENT

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The Great Salt Lake (GSL) is a critical breeding site for waterbirds in North America. At least 34 waterbird species (shorebirds, waterfowl, and colonial waterbirds) nest at GSL. The breeding populations of many species are among the highest in North America. Thus, it is critical we understand the factors affecting their population health. Over the past five years I have monitored the productivity of waterbirds at eight sites throughout GSL. This data-set represents over 10,000 individual nest records of 18 species. Results indicate that predation is the most important cause of nest failure. Sites with intensive predator management had higher daily nest survival relative to unmanaged sites. Video recordings at nests revealed raccoons were the most important nest predator. Nests located near dikes experienced significantly higher rates of nest predation and this effect persisted for up to 100m. These results suggest that predators utilize dikes at many of the study sites as travel corridors. This knowledge is essential for the successful conservation and management of waterbird populations at one of the most important breeding sites in North America. [Session 10]

QATTARA DEPRESSION-A NEW SALT LAKE

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A proposal to inject Mediterranean Sea water into the Qattara Depression (Egypt) for power production is analyzed. Expressions for the area, A, the volume, V, of the depression are developed as functions of the depth, Y. A differential equation for the volume, V, as a function of time, T, is derived. Solutions are shown in an accompanying table and graph for two time intervals over a period of 50 years. A differential equation for the salt content, Z, is derived and solved and shown in a graph as well as a table. The density, R, is determined for the first 50 years, and shown in tabular and graphical form as a function of time, T. Additionally the equation for water power, WP, for the Qattara Salt Lake is developed for the two time intervals. Three beneficial scenarios resulting from the creation of the lake are discussed, including the use of Pressure Retarded Osmosis (PRO) as a power source. [Session 13]

OXYGEN PRODUCTION AND USE IN BENTHIC MATS OF SOLAR SALT PONDS

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A method of quantifying the generation of oxygen from benthic algal mats has been developed as a potential method of describing primary production in constructed solar salt fields. The benthic mat is important for solar salt production as it reduces loss of brine from the field, supports species which can have a serious detrimental effect on the crystallisation process, and removes as well as reintroduces nutrients into the water column. The primary productivity activity of the mat in the fields studied increase with salinity and is at it's highest just prior to gypsum precipitation and reduces as the salinity increases to halite precipitation. Oxygen reduction is greater in the gypsum ponds. Most salt fields would appear to be net carbon sequesters. [Session 4]

ALTERNATIVE STABLE STATES - A TOOL FOR MONITORING ECOSYSTEM CONDITION IN SOLAR SALTFIELDS

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Monitoring solar saltfield ecological health has been a relatively expensive process, requiring the use of highly skilled professionals. As a result, many smaller commercial operations are monitored less frequently than ideal. An approach to monitoring solar saltfield ecological condition has been developed, based on observations of salina alternative steady states. The proposed methodology is easy to implement and economical, addressing the day-to-day monitoring needs of small saltfields. [Poster]

CONCENTRATION OF MERCURY AND SELENIUM ON GREAT SALT LAKE BIRDS AND EFFECTS ON AVIAN HEALTH

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We examined selenium and mercury concentrations in California gulls (*Larus californicus*) nesting on the Great Salt Lake (GSL), eared grebes (*Podiceps nigricollis)* staging during the fall on GSL, and wintering ducks on GSL. On a dry-weight basis, mean selenium concentration in gulls was 18.1 µg/g in blood, 8.1 in livers, and 3.0 µg/g in eggs. Mean selenium concentrations in grebes was 11.6 µg/g in liver and 9.0 µg/g in blood. Mercury concentrations in grebe blood was 7.0 µg/g. Hg and Se concentrations were often correlated together. Mercury and selenium concentrations varied based on where the animal was collected on the Great Salt Lake. Hg and Se levels increased as birds increased their stay on GSL. There was no evidence that the high levels of selenium and mercury were having an adverse effect on avian health, mass, or reproductive ability. This lack on an effect may result from mercury and selenium interacting to form a complex that is less toxic than other forms of selenium and mercury. [Session 8]

CLIMATOLOGY OF GREAT SALT LAKE SURFACE TEMPERATURE FROM MODIS

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Utah's hypersaline Great Salt Lake (GSL) has been an object of observation since the advent of satellite imagery. However, no comprehensive study of lake surface temperature (LST) has been conducted on the basis of remote sensing. A climatology of GSL LST between 2000-2007 has been processed using thermal imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS). Documenting the spatial and temporal variations in LST has wide-ranging applications for the biological, limnological, and meteorological understanding of the GSL environment. The effects of lake level, bathymetry, river inflow, thermal stratification, wind speed, water clarity and salinity on LST have been documented. Solar forcing and thermal stratification of the shallow lake leads to diurnal variations in LST of 1-5 degrees Celsius and an annual range in LST approaching 30 degrees Celsius. The largest mean diurnal LST variations occur in the spring (3 degrees Celsius) with the smallest mean diurnal LST variations in the fall and winter (1.5 degrees Celsius). Interannual variations in LST are largest in the fall and smallest in the summer. [Session 13]

EXPLORING THE USE OF HALOPHYTIC GREEN ALGAE FOR BIOFUEL PRODUCTION

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Halophytic (salt-loving) green algae are ideally suited as a non-seasonal, renewable energy resource for the arid western U.S. because they can be more productive than terrestrial oilseed crop feedstocks, can be grown on marginal lands with brackish or saline water unsuitable for traditional agriculture, can leverage geothermal and solar resources, and provide widespread potential for sequestration of CO2 from biomass, coal, and gas-fired power plants. The long-term goal of the proposed research is to optimize and implement the use of halophytic microalgae as a biofuel crop. Specific research goals are 1) to determine the lipid production potential for various strains of *Dunaliella* and other halophytic species and assess the quality of biodiesel produced from these species; 2) to conduct mutant screens to determine the feasibility of identifying *Dunaliella* stains with enhanced production of triacylglycerols (TAGs) suitable for conversion to biodiesel; and 3) to identify genes that control oil production by mRNA expression profiling using the complete genome sequence data from *Dunaliella salina* CCAP 19/18. [Session 4]

IRON LIMITATION IN SALINE LAKES OF THE NORTHERN GREAT PLAINS

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Past research in prairie saline lakes has indicated complex nutrient limitation patterns of primary production, as the relative importance of nitrogen (N), phosphorus (P), and iron (Fe) varies across these systems. A protein assay called the ferredoxin (Fd) index can be used to assess potential iron limitation in algae. This assay indicated possible iron deficiency in a sub-set of saline lakes across the Northern Great Plains. To further explore these nutrient limitation patterns, we established a series of nutrient enrichment experiments in late spring and summer in three lakes, all of which had Fd indices indicative of possible iron deficiency. In addition to the control (no nutrients added), treatments consisted of N, P, Fe, or N&Fe enrichment; a triplicate of each of the treatments were incubated in one-liter cubitainers for one week. Final chlorophyll concentrations were assessed along with phytoplankton community structure. Nitrogen stimulated algal growth in all three lakes in both seasons; in some cases, an additional response to Fe enrichment was observed. Differences in the response to nutrient influence on phytoplankton richness and abundance will be discussed. [Poster]

DYNAMICS OF MERCURY IN EARED GREBES ON THE GREAT SALT LAKE

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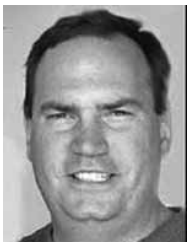

We measured total mercury in feathers (both primary and breast) and total and methylmercury in liver and breast muscle of eared grebes (*Podiceps nigricollis*) after fall arrival at both Mono Lake, California and Great Salt Lake, Utah and again prior to their departure to southern wintering areas. Mercury in the birds from Great Salt Lake increased in all tissues except primary feathers during a 64-day period between October and December. Liver tissue had the most pronounced change in total mercury which increased nearly threefold from a mean of 10.2 mg/kg to 27.4 mg/kg on a dry weight basis. Mean concentrations of mercury in all tissues from birds at Great Salt Lake were higher than those from Mono Lake. When compared with historic data, it appears that mercury has increased substantially in Great Salt Lake grebes through time. A similar increase was also observed in brine shrimp (*Artemia franciscana*), the predominant food item of grebes at Great Salt Lake. [Session 11]

THE EFFECT OF SALT ON GERMINATION OF SAMPHIRE SPECIES

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Nine *Halosarcia* species from Lake Carey, Western Australia, were tested to determine the effect of salt on germination. All species were subjected to salt concentrations of 0, 10, 20 and 30g/L NaCl in both laboratory and experimental settings. Increased NaCl concentrations resulted in germination rates decreasing, both in the laboratory and experimental settings for the majority of species with the exception of *H. halocnemoides*, which showed a slight increase in germination rates at higher concentrations. In laboratory trials the greatest reduction in germination rates was 81% for H. Angel Fish Islandí, with the average reduction being 37% across all species. Within experimental settings germination only reached a maximum of 25%, which could be due to lack of moisture, scarification of seeds or temperature. The species were also tested for their ability to recover from high NaCl concentrations, which showed an average of 58% germination once seeds were flushed with fresh water. [Session 9]

THE PHASE RULE STUDY FOR THE RECOVERY OF MARINE CHEMICALS FROM SEA BITTERN

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The marine salt deposits were formed by the evaporation of seawater, which contain the principal ions Na^+, K^+, Mg_2^+, Ca_2^+, Cl^-, and SO_4^{-2}, with water, these ions constitute a six-component system. Such recovery is based on understanding of the composition and solubility relationships of the various salts obtainable from seawater, both under ambient conditions and as a function of temperature. The best way to find out how to extract particular salts from a multi component system is to define their precipitation fields in the phase diagram representing the system containing the major elements of the brines: Na^+, K^+, Mg_2^+, Ca_2^+ Cl^-, SO_4^{-2}, CO_3^{-2}, H_2O. Carnallite formation is promoted when $[Mg^{+2}]$ to $[K^+]$ and $[Cl^-]$ to $[SO_4^{-2}]$ ratios is both high, as evident from the phase diagram. The desulfated oceanic bittern allowing direct and efficient recovery up to 80% of the KCl in the form of sylvinite (NaCl-KCl), which can be processed further to obtain pure KCl, by passing Carnallite (KCl $MgCl_2$ $6H_2O$) phase. The K+ concentration in Dead Sea brine is 0.617 % (w/v) while desulfated bittern has maximum up to 2.10 % (w/v) which favors sylvite production. [Poster]

SOLID-LIQUID METASTABLE PHASE EQUILIBRIA IN THE AQUEOUS SYSTEM OF POTASSIUM SULFATE AND MAGNESIUM SULFATE AT 288.15 K AND 308.15 K

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Metastable solubilities and the physicochemical properties of the system were determined with an isothermal evaporation method. Based on the experimental data, the phase diagram and the physicochemical properties were plotted against the composition diagrams. It was found that there are in all: two invariant points, three univariant solubility curves, and three metastable crystallization regions corresponding to anhydrous potassium sulfate, picromerite and epsomite formed in the metastable equilibrium system. A comparison of the stable and metastable phase diagrams at each temperature shows that the metastable phenomenon of magnesium sulfate is obvious, and the crystallizing regions of epsomite and anhydrous sulfate are much larger than those in the stable phase diagrams. The physicochemical properties of the system changed regularly with the content of magnesium sulfate. The information can be used to remove potassium or remove magnesium. The calculated densities using the empirical equation agree well with the experimental results. [Session 7]

VOLATILE SELENIUM FLUX FROM THE GREAT SALT LAKE, UTAH

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Volatilization of Se has been proven to be the major source of Se vapor from oceans and estuaries and it may be the major mechanism of permanent Se removal from the Great Salt Lake (GSL). However, the volatilization flux of selenium from the Great Salt Lake has not been previously measured due to challenges of analysis in this hyper-saline environment. This work presents results from recent field studies examining the spatial distribution (geographical and with depth) of volatile Se in the South Arm of GSL. The analyses involved collection of volatile Se in a cryo-focusing trap system via sparging with helium, sample digestion with nitric acid and analysis via ICP-MS. Volatile Se flux to the atmosphere was determined using mass transport models corrected to simulate the highly saline environment of the South Arm of the GSL. The geometric mean volatile Se flux in the GSL was estimated to be 2108 Kg/yr, within a range between 357 Kg/yr to 12,437 Kg/yr at the 68% confidence level. Direct measurements of volatile Se flux in the lake confirmed the values obtained from modeling. [Session 8]

DAILY CHANGES IN DISSOLVED SELENIUM IN A WETLAND OF THE GREAT SALT LAKE: OCCURRENCE AND CAUSES

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Daily changes in selenium (Se) speciation were simulated and coupled to a mass transfer model to determine whether the simulated dissolved Se concentrations in the aqueous phase matched field observations. The simulation showed that the major physical mechanisms of Se affecting diel changes in dissolved Se during oxic conditions were sedimentation of Se associated with suspended matter and volatilization of gaseous forms of Se. During periods corresponding to anoxic conditions, chemical precipitation of dissolved Se as metal selenides (e.g., Ag_2Se) predominated the geochemistry of Se. The Se mass balance simulation matched well the observed Se concentrations. Settling and volatilization of Se accounted for approximately 99% and 1% of the dissolved Se lost from the water column. [Session 8]

SEPARATION AND EXTRACTION OF STRONTIUM FROM OIL FIELD BRINE OF NANYISHAN REGION

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The oil field brines of Nanyishan are rich resources of K, Li, Ca,. B, Br, I, Sr, Rb and Cs. According to a scientific analytical survey, the average concentration of strontium in the brines is 5363.76mg/l, which is a valuable exploitable resource. After concentration via evaporation, followed by cooling, most of Sr is precipitated in the solid phase. By further processing of the solid phase, strontium is separated and extracted. The physicochemical properties of Ca and Sr are quite similar, whereas the solubility of $Ca(OH)_2$ and Sr(OH)2 are quite different. Utilizing this difference, the procedure for separating Ca and Sr is designed as follows: NaOH (10%, 2M) is added in excess to a mixed solution containing calcium and strontium resulting in the formation of a white precipitate. The mixture is heated and filtered at high temperature to remove the white solid ($Ca(OH)_2$). After the filtrate was settled overnight, additional white solids were obtained. Sulfuric acid H_2SO_4 (2M) was added to the white solid. $SrSO_4$ was precipitated, which was collected for further processing. [Poster]

GENETIC COMPARISON OF ARTEMIA FRANCISCANA AND AN IRANIAN ARTEMIA STOCK FROM MAHARLU LAKE USING PCR-RAPD TECHNIQUE

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Random Amplified polymorphic DNA (RAPD) markers were used to determine genetic patterns of *Artemia franciscana* and an Iranian *Artemia* stock from Southern part of Iran (Shiraz, Fars province, Maharlu Lake). Both *Artemia* populations examined had similar Nei genetic diversity and Shannon index values. UPGMA dendrogram and PCA analysis constructed based on Nei genetic distance revealed a single cluster among them. The same genetic structure for both *Artemia* populations surveyed was also proved by heterozygosity(Hete. = 0/14 vs 0/13). Furthermore, our research showed that Iranian native parthenogenetic *Artemia* from Maharlu Lake has the same life cycle characteristics as *Artemia franciscana*. RFLP results from other research revealed that Iranian *Artemia* stock from Maharlu Lake has high genetic similarity with *Artemia franciscana*. From this finding, one hypothesis can be drawn: according to the published literature, *Artemia* stock at Maharlu Lake is parthenogenetic but due to entering *Artemia franciscana* cysts through man-made activities and migratory birds, they are mixing. In conclusion, conservation management policies should be applied to Iranian *Artemia* stock in order to maintain biodiversity and native populations in Iran. [Session 9]

ASSESSING THE ROLE OF DUST FROM SALT LAKES AND LAKE DEPOSITS FOR THE GLOBAL DUST BUDGET

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The identification of dust sources and their characteristics is crucial for our understanding of atmospheric dust variability and global climate modeling efforts. We identify 132 dust hotspots in global desert regions based on the satellite-derived long-term mean TOMS Aerosol Index (TOMS AI). We use satellite imagery and cartographic materials to classify the hotspots according to four primary dust source sediment characteristics, 1) salt lake/lake deposits, 2) fluvial deposits, 3) dunes and 4) agriculture. This qualitative comparison shows that almost half of the global dust hotspots (45%) are associated with salt lake/lake deposits. This highlights the importance of these dust sources with respect to expected changes in hydrological cycles due to future climate change. Although, among the four source characteristics, average emissions from salt lake/lake deposit-associated sources are lowest on a global scale, average emissions can be highest on a regional to continental scale as in the case of North Africa, South Africa, North America and South America. The analysis of dust emissions associated with the occurrence of multiple source sediment characteristics reveals interesting patterns. [Session 5]

PHYSICAL AND CHEMICAL CHARACTERIZATION OF PARTICULATES FROM THE GREAT SALT LAKE, UTAH

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The characterization of trace metals in terms of their apportionment among dissolved, macromolecular, nano- and micro-particulate phases in the water column of the Great Salt Lake is important to determine the transport and fate of contamination entering into the food web of the lake. Samples from the Great Salt Lake anoxic deep and oxic shallow brines were fractionated among dissolved, macromolecular and nanoparticulate sizes using asymmetric flow field flow fractionation. The associated trace metals were measured via on-line collision cell inductively-coupled plasma mass spectrometry. Results showed that trace metals were associated mainly with particulates larger than 450 nm. In the lower nanoparticulate size, trace metals were associated with particulates in the size range between 1 to 50 nm. Geochemical modeling using USGS PHREEQC software suggested that trace metals were sorbed or co-precipitated to Al and Fe oxyhydroxides in the oxic shallow brine of the south arm of the Great Salt Lake; while trace metals would be in form of sulfides, selenides or bound with Al oxyhydroxides in the anoxic deep brine of that part of the lake. [Session 8]

GEOCHEMISTRY AND POTENTIAL PLAYA SOURCES OF THE JANUARY 7, 2008 SOUTHWESTERN NEW MEXICO "MILKY RAIN"

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On January 7, 2008, 1300 km2 of Grant County, New Mexico (USA) received milky-white rain. Residents collected samples, then contacted area universities and state agencies to arrange for chemical analyses. Initial speculation targeted mine tailings, or volcanic ash mixing with rain before wind back trajectories and satellite images suggested a regional source: Willcox Playa (Arizona) sediments. Other rare "milky rain" events worldwide have been traced to dust from saline lake basins. Analysis of major ions indicated elevated calcium, sodium, sulfate and chloride levels, consistent with playa-type deposits. A National Atmospheric Deposition Program site at the Gila Cliff Dwellings showed the rain's calcium content to be within the top 1.0% of all data gathered by the network in a typical 5-year period. The New Mexico Environment Department concluded that the event samples had similar chemistry to surface waters obtained from the Lordsburg Playas (New Mexico) in the early 1990's. Continuing research includes trace element analyses of dissolved constituents, suspended materials and dust samples. We present an overview of this event, its potential causes, and the geochemistry of the materials. [Session 5]

SALT FLAT BASIN'S CONTRIBUTION TO REGIONAL DUST PRODUCTION AND POTENTIAL INFLUENCE ON DRY DEPOSITION IN THE GUADALUPE MOUNTAINS (TEXAS)

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In this study we investigated the impact of the ephemeral lakes of the Salt Flat Basin (western Texas) on aeolian transport within the basin and their impact on regional aerosol loadings. The basin is immediately west of the Guadalupe Mountains, which include a national park and an Interagency Monitoring of Protected Visual Environments (IMPROVE) aerosol monitoring station. We monitored seasonal, spatial, and temporal variations in the composition and size of aerosols and wind-erodible sediments on the playa and at the IMPROVE site. Dust samples were obtained in the field, analyzed for particle size and chemistry, and compared to historical aerosol data in the IMPROVE database, to discern potential impacts of dust emissions from the Salt Flat Basin on dry deposition in the surrounding uplands. Dust production and composition are highly variable, depending on climatic conditions such as precipitation, wind speed and wind direction: sediment mineralogy and particle size are also patchy within the Salt Flat Basin floor. While the playa regularly produces large dust plumes, it appears that they are not presently dominating aerosol loadings at the IMPROVE site. [Session 5]

SCIENTIFIC INQUIRY FOR K-12 STUDENTS AT GREAT SALT LAKE: A PARTNERSHIP BETWEEN THE UNIVERSITY OF UTAH, PUBLIC AGENCIES, ADVOCACY GROUPS AND THE K-12 COMMUNITY

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WEST (Water, the Environment, Science and Teaching) is a science education program at the University of Utah that partners graduate students with K-12 (kindergarten through 12th grade) teachers to enhance inquiry-based science teaching in public schools. Great Salt Lake, a large closed-basin lake northwest of Salt Lake City, serves as a natural laboratory for teaching about the water cycle, water chemistry, wetland ecosystems, avian ecology, saline lake biota, and human interactions with the environment. WEST has teamed up with researchers from the University of Utah, the U.S.G.S., the Utah Department of Environmental Quality, and Friends of Great Salt Lake to develop a series of field trips that involve K-12 students in a research project to study the effects of anthropogenic influences on the lake. Students participate in a research cruise where they learn about navigation tools, collect brine shrimp, observe waterfowl, measure concentrations of sulfide and chlorophyll, and examine temperature and density profiles. It is hoped that the students' participation in this project will give context and meaning to the concepts learned and solidify an interest in the hemispherically important Great Salt Lake ecosystem. [Session 12]

CURRENT STATE AND LONG-TERM CHANGES OF HYDROCHEMICAL REGIME AND PRIMARY PRODUCTION IN SALT WATER BODIES OF SOUTH OF UKRAINE

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In the recent history of the ecological state of the natural waters of Ukraine there are three periods: (1) - the natural state (up to the late sixties), (2) - heavy anthropogenic eutrophication (1970-1991), (3) - reduction of anthropogenic eutrophication, de-eutrophication (1991- present). During the first period, water ecosystems did not experience considerable anthropogenic influence. During second period, considerable amounts of nitrogen and phosphorus started entering into water as a result of intensification of agriculture and industry. The collapse of the Soviet Union in 1991 caused an economical fall, followed by a reduction of anthropogenic eutrophication. In the water bodies in contrast to the 1980s decrease of content of mineral nitrogen (usually 2 – 3 times, some times up to two orders of magnitude), of phosphorus (in 2 – 5 times) and also the organic matter (in 2 – 3 times). But the change of primary production value is insignificant. However, at present the amount of nutrients and organic matter exceeds their original level (1960s) many times. For example, organic matter concentrations are 2-10 folds higher, and phosphorus concentration is 1-2 orders of magnitude higher. [Session 2]

ISOLATION AND IDENTIFICATION OF SELENITE REDUCING ARCHAEA FROM TUZ (SALT) LAKE IN TURKEY

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Selenium (Se), a metalloid, occupies a unique position as regard to continuing conflicting aspects of its toxicological and nutritional significance. A few microorganisms are reported to tolerate or reduce these toxic selenium species into non-toxic forms and thus, bioremediation has been considered as an effective means of cleaning up of selenium contaminated areas. In this study, we describe the ability of a Tuz lake strain, designated as 106, to deposit selenium-containing particles, as determined using TEM. The cells were deposited on Formvar-coated 300 mesh copper grids. Cells were fixed with 2.5% gluteraldehyde in 0.1M phosphate buffer (pH 7.4) and stained in 2 % osmium tetroxide. Cells were embedded in EPON 812, and were thin-sectioned using a diamond knife to a thickness of 100 nm. The sections were stained with lead citrate and uranyl acetate. Electron micrographs shows intact cells after selenite reduction and large amounts of selenium-containing particles are present in the culture medium indicating that strain 106 is able to efficiently transport elemental selenium out of the cell. [Poster]

THE EFFECTS OF DROUGHT ON REPRODUCTION MODE OF ARTEMIA URMIANA

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Reproductive mode of *Artemia urmiana* in Urmia Lake (northwest Iran) was examined during the period, 1993-2003. Variation in physiochemical parameters measured concurrently with *Artemia* sampling allowed the effect of salinity on reproductive mode of *A. urmiana* to be obtained naturally. Because of low precipitation and high evaporation after 1999, salinity increased and the reproduction mode of *A. urmiana* shifted from a mix of ovoviviparity and oviparity to one consisting entirely of oviparity. [Session 14]

COMPARATIVE CHANGES IN THE HYDROCHEMISTRY OF THE ARAL SEA, UZBEKISTAN (2002 TO 2007) AND KARABOGOZGOL, TURKMENISTAN (2000 TO 2002) AND THE CORRESPONDING ALTERATIONS IN RESIDENT BIOTA

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The Aral Sea has been claimed to be one of the worst human-induced ecological disasters of this century. Research investigations into the hydrochemical modifications were undertaken to document the changes in the Aral Sea and to assess the impact of such changes on the resident biota. The hydrochemical characteristics are compared to those observed following the re-introduction of Caspian Sea water into the KarabogozGol basin. Both systems exhibited a steady increase in salinity coupled with pronounced impacts on vertebrate and invertebrate species. The Aral Sea salinity crested above 75 ppt in October 2002 and there has been little evidence of surviving vertebrate species in the Aral since that time. Nitrogen appears to be a limiting factor constraining the growth of phytoplankton, thereby restraining the emerging *Artemia* population. Historic concentrations of essential elements and nutrients are contrasted with current assessments. [Session 2]

GLOBAL PHYLOGEOGRAPHY OF DUNALIELLA

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Nearly all cultured isolates of the common halophilic chlorophyte alga, *Dunaliella* are from saline aquatic habitats. We obtained many new terrestrial isolates of *Dunaliella* from the Great Salt Plains (GSP) of Oklahoma, a salt flat with extreme temporal and spatial fluctuations in salinity and temperature. Molecular phylogenetic and evolutionary analyses indicate that *Dunaliella* from the GSP (and two similar habitats in the Great Basin of Nevada and Utah) reveal broad phylogenetic diversity and statistically higher rates of nucleotide substitution than the phylogenetically homogeneous set of aquatic *Dunaliella* taxa. The diverse GSP *Dunaliella* strains exhibit three morphotypes with varied and broad salinity optima well below typical in situ salinities recorded at the GSP, suggesting chronic slow growth and osmotic stress. We propose that a combination of elevated net substitution rates and temporal and spatial niche separation enhance diversification in hypervariable terrestrial habitats such as the GSP, compared to more stable aquatic habitats. Our data indicate that extremophiles such as *Dunaliella* are likely to provide tractable microbial models for in situ testing of evolutionary and phylogeographic hypotheses. [Session 4]

EXPERIMENTAL STUDIES OF CHANGES IN BENTHIC INVERTEBRATE COMMUNITY COMPOSITION AND PRODUCTIVITY OVER SALINITY GRADIENTS

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Observations from field studies have suggested that the productivity of saline lake invertebrates may be maximized at salinities intermediate between physiological stress at high salinity and biotic interactions at low salinity (the “intermediate salinity hypothesis”). As a test of this, salt concentration was varied using experimental mesocosms at Mono Lake and microcosms at Owens Lake to study the response of salt-tolerant brine flies (ephydridae). Seeded and colonizing populations of benthic insects were dominated by *Ephydra hians* and *E. auripes*. Increased salinity in Mono Lake mesocosms (50–150 g/L) resulted in reduced populations of *E. hians* larvae and pupae, lower adult emergence rates, and smaller size at maturity (pupa and adult body size). Smaller adults also showed lower lipid storage and fecundity. Salinity varied over a range of 10–100 g/L in Owens Lake microcosms produced greatest densities of ephydrids at moderate salinities. Reduced densities at low salinity were accompanied by increased numbers of potential predators and competitors even though optimum development in cultures was found at these same low salinities. These studies provide experimental support for the intermediate salinity hypothesis. [Session 3]

EXPERIMENTAL LABORATORY STUDY OF PHYTOPLANKTON COMMUNITY NUTRIENT LIMITATION ACROSS A SALINITY GRADIENT IN THE SANDHILLS LAKES OF NEBRASKA

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The response of phytoplankton communities to nutrient additions was examined in seven lakes in the Nebraska Sandhills region. The major ions in these shallow polymictic lakes include Na^+ and HCO_3^- and lakes ranged from freshwater to hypersaline (salinity = 0.17-33.8 ppt). Sampled lakes had N:P ratios of 3-46 and were dominated by cyanobacteria. Four of the seven lakes were considered to be P limited based on the Redfield Ratio. Water collected from each lake was placed in culture tubes with each tube receiving one of 31 treatments with 3 replicates for each. The treatments included additions of all combinations of the following nutrients: N, P, Fe, Mo, and SO_4. Nutrients were added to all tubes at twice the concentration of the highest concentration found naturally for all lakes. After seven days, phytoplankton growth was estimated by chlorophyll a. Nitrogen was the primary limiting nutrient for phytoplankton growth in six out of seven lakes, while Fe was the primary growth limiting nutrient in one lake. [Session 6]

DEVELOPING VEGETATION METRICS FOR 305(B)/303(D) ASSESSMENTS FOR GREAT SALT LAKE IMPOUNDED WETLANDS

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Many wetlands around Farmington Bay are managed waterfowl habitat by means of impounding flows largely composed of effluent. These waters have elevated phosphorous yet the wetlands may have reached their assimilatory capacity for nutrient removal. To develop metrics that describe the relationship between nutrient gradients and biological responses, we are 1) testing potentially useful parameters for their utility in assessing wetland condition; and 2) refining condition metrics that will identify thresholds of significant change (impairment) that can be attributed to nutrients. Analysis of 2004–2005 data identified submersed aquatic vegetation (SAV) percent cover as a sensitive metric showing fall senescence in target wetlands (nutrient rich) versus no senescence in reference wetlands at a time when migratory waterfowl rely on SAV for sustenance. In exploring direct causal relationships between nutrient enrichment and degradation of the wetland, we looked at water column light attenuation, including areas shaded by duck weed and algae. Preliminary comparisons between light profiles and biomass show major differences between target and references conditions, however, stress related to shading needs further elucidation. Future research will continue to refine these potential metrics and investigate physiological cues from the SAV. [Session 3]

BIODIVERSITY OF INLAND SALTSCAPES OF THE IBERIAN PENINSULA

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The Iberian Peninsula hosts a wide variety of inland saltscapes, from man-made solar evaporation salterns to hypersaline lakes and salt rivers, most of them unknown in other European latitudes. The present contribution deals with this diversity of saltscapes, briefly introducing their main features and locations and presents a general overview of their conservation status. Some of their natural values are not even well understood by the scientists themselves and therefore are very rare and fragile and in need of protection. However, many of these natural saltscapes have been and are currently under threat, having been desiccated, used as waste dumps or polluted with irrigation runoff. Loss of production in recent decades in artificial salinas has negatively affected their halophyllic plant and animal communities, given that conditions in salinas depend very much on the salt making activity itself. These results are based on empiric field observations and a comprehensive inventory and status report of Iberian saltscapes is needed to support the ideas presented here. [Session 9]

POLITICAL CORRECTNESS, FEAR, VENALITY AND ENVIRONMENTAL DESTRUCTION

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This talk is dedicated to the memory of Bill Williams, founder of ISSLR, host for its first meeting in 1978, and one of the first people to point out how exceptionally vulnerable salt lakes are to human interference and human population growth, his adopted country of Australia providing many good examples. Garrett Hardin, author of Tragedy of the Commons and another early thinker on these issues, emphasized the need for each country to accept responsibility for its own population planning. My talk concerns how normal human weaknesses interact with the restrictive but different subcultures of academia, government agencies, and environmental organizations, with severe negative societal consequences. Suppression of reasoned discussion about population-environment relations is routine. Progress in dealing with environmental issues is stymied. Well-behaved technocrats are allowed to stay on the gravy train only if they leave all the policy discussions to the 'big boys upstairs.' I document these propositions with tales from my experience as a scientist and pot-stirrer involved with scientific research and restoration planning for the Salton Sea and the Columbia River and its salmon fisheries. [Session 9]

LONG-TERM SEASONAL SHIFTS IN ARTEMIA ABUNDANCE ASSOCIATED WITH DECREASING SALINITY AND LARVAL RECRUITMENT BOTTLENECKS IN HYPERSALINE MONO LAKE, CALIFORNIA

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The zooplankton of Mono Lake are dominated by a single species, the brine shrimp, *Artemia monica*. Over-wintering cysts hatch in spring and by late-May adults begin ovoviviparous reproduction of a second generation. Adult abundance of the 1st generation (May-June) is positively correlated with March water temperature and phytoplankton abundance, and negatively correlated with salinity. Adult abundance of the summer population (July-Aug) is inversely correlated with May-June ovoviviparous reproduction due to a pronounced larval bottleneck experienced by early instars when abundant 1st generation shrimp graze phytoplankton to low concentrations. [Session 14]

CHANGES IN BIOLOGICAL RESOURCE AND ENVIRONMENT IN THE DECADE OF GAHAI SALT LAKE, CHINA

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Gahai Salt Lake is situated in the northern Qinghai-Tibet plateau (37°05.58'-37°10.00' N and 97°31.33'-97°36.46' E, ALT 2848 m, area 37 Km^2 and depth 15 m). It is one of the most important producers of high quality *Artemia* eggs in China. However, since 1998, egg yield has declined and egg quality has diminished. Specifically, egg yield decreased sharply in 2007, to <1/10 of the average yield of the previous 10 years. This paper reports the changes of the population structure and reproduction ability of the *Artemia*, air temperatures and precipitation, water levels and salinity of the waters, quantity and quality of bait and primary productivity. Environmental problems resulting from human long-term barbaric catching and recent industrial pollution and their effects on *Artemia* resources and egg quality have been examined as the cause of the sharp decrease of *Artemia* egg production in 2007. [Poster]

SELENIUM MASS BALANCE FROM THE GREAT SALT LAKE, UTAH

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A mass balance for Se in the south arm of the Great Salt Lake (GSL) was developed for a 1-year period of monitoring Se loads and removal fluxes. The combined removal fluxes (sedimentation and volatilization) totaled to a geometric mean value of 2600 Kg/yr, within a range between 400 Kg/yr and 13,500 Kg/yr at the 68% confidence level. The total loads (via runoff) were about 1500 Kg/yr ± 15%. Comparison of volatilization to sedimentation flux demonstrates that volatilization rather than sedimentation is likely the major mechanism of Se removal from GSL. Measured loss fluxes balance (within the range of uncertainties), and possibly surpass, measured annual loads. Surprisingly, the measured total Se concentration increased during the period of the study despite the apparent balance of losses and gains. This discrepancy indicates that the removal processes operate at their low estimated rates, and/or there are unmeasured Se loads entering the lake, and this was corroborated by mass balance integration. The Se trajectories were compared to those of other trace metals with similar geochemical characteristics to assess the significance of Se trends. [Session 8]

MANAGEMENT OF THE GREAT SALT LAKE FOR SUSTAINED ARTEMIA HARVEST AND ECOSYSTEM CONSERVATION: AN OVERVIEW OF THE GREAT SALT LAKE ECOSYSTEM PROGRAM

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The Utah Division of Wildlife Resources initiated the Great Salt Lake Ecosystem Program in 1996 to address the issues of sustainable *Artemia* cyst harvest and conservation of Great Salt Lake (GSL) resources for wildlife populations. Since that time the program has monitored the *Artemia* population and limnological factors that influence it, as well as cyst harvest levels and avian populations. We present here an overview of the program, management goals and policies, and general trends from population and harvest monitoring. Increased frequency of monitoring has provided data suggesting *Artemia* in GSL produce 3-4 generations per growing season, depending on availability of suitable phytoplankton. Our field data confirmed that 40-50% of remaining winter cysts hatch into nauplii in early spring, and indicated reduced sub-adult and adult survival at temperatures over 25°C. Since 1996, an average of 5,512 metric tons (range 1,194-11,671 metric tons) of raw biomass has been collected each year by cyst harvesters. Despite seasonal removal of cysts, the *Artemia* population is able to recover and to reach high densities in favorable conditions, providing for continued annual harvest. [Poster]

CHARACTERIZATION OF A PICOPLANKTON ISOLATED FROM SODA LAKE IN INNER MONGOLIA OF CHINA

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The soda lake is located in Inner Mongolia on the Xilinhaote plateau that has an elevation of up to 1,200 meters. The nitrogen and phosphorus contents of salt lakes in this area are higher than in lakes of other regions of China. The average TP is about 0.4-0.6 mg/L and the average TN is about 10-20 mg/L. In the soda lake on the Xilinhaote plateau, one kind of predominant picoplankton alga bloomed all throughout the year. The picoplankton alga was isolated. The cells are spherical or oval with about 2-3 μm in diameter. The optimal salinity for growth was 0.5-1 M NaCl, and cells grew well between pH 7 to 12. The phylogenetic analysis of the 18S rDNA gene suggested that the picoplankton isolate was the green algae *Picocystis salinarum*. [Session 4]

CURRENT-USE PESTICIDES IN THE SALTON SEA, CALIFORNIA: UNDERSTANDING INPUTS AND IMPLICATIONS FOR RESTORATION

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The Salton Sea, a hypersaline lake in southeastern California surrounded by intense agricultural production, receives the majority of its freshwater input from the Alamo and New rivers. A decade of study by the U.S. Geological Survey has shown that the rivers transport a complex mixture of current-use pesticides to the Sea throughout the year with thirty-four different pesticides detected in water and suspended sediments. Herbicides were detected the most frequently and at the highest concentrations. Dissolved concentrations of four organophosphate insecticides periodically exceeded aquatic life benchmarks established by the U.S. Environmental Protection Agency while suspended sediments contained a mixture of pyrethroid insecticides. Fungicides were also detected, but less frequently and at lower concentrations. In the future, planned water transfers and restoration efforts are likely to decrease freshwater inflows and increase salinity, thus affecting the input and fate of current-use pesticides. In addition, exposure of bed sediments from a decrease in lake size would create the potential for atmospheric transport of pesticides associated with dust. Monitoring of contaminants, including current-use pesticides, is critical as the Salton Sea undergoes restoration. [Session 11]

A STUDY ON SPECIES ENVIRONMENT RELATIONSHIP OF COPOSA SALAR IN THE HIGHER ALTITUDES OF NORTHERN CHILE

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There are eight large saline lakes at higher altitudes in Chile. These are Surire, Lagunilla, Huasco, Coposa, Michincha, Atacama, Punta Negra and Ascotan. These saline lakes are increasingly desiccating due to minimal natural recharge. Four of them are managed by an artificial irrigation system. The present study deals with the interconected Jachucoposa fresh water ecosystem and Coposa saline ecosystem before and after artificial irrigation of 30 to 50 L/s. Around 20 environmental variables (Temperature, salinity, pH, TDS, Na, Ca, Mg, Mn, B, As, NO_3, PO_4, Organic carbon, $CaCO_3$, Cl, SO_4, CO_3, and HCO_3) and species composition data of 14 macroinvertebrates, 17 microalgae, 14 epibenthic microinvertebrates and 7 bacteria were analysed over the two years to determine the species environment relationship by the “Canonical Correspondence Analysis'. The total water volume flow above 30 L/s has significant impact on the total species population but total biodiversity of the ecosystem was maintained. Total phosphate, nitrate and calcium carbonate were positively correlated with invertebrates, microalgae and bacteria in the sediments. [Session 9]

ANALYSES OF SELENITE ACCUMULATING ARCHAEA ISOLATED FROM TUZ (SALT) LAKE IN TURKEY BY TRANSMISSION ELEKTRON MICROSCOPE

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Selenium (Se), a metalloid, occupies a unique position as regard to continuing conflicting aspects of its toxicological and nutritional significance. A few microorganisms are reported to tolerate or reduce these toxic selenium species into non-toxic forms and thus, bioremediation has been considered as an effective means of clenaing up of selenium contaminated areas. In this study, we describe the ability of a Tuz lake strain, designated as 106, to deposite selenium-containing particles using by TEM. The cells were deposited on Formvar-coated 300 mesh copper grids . Cells were fixed with %2,5 gluteraldehyde in 0,1M phosphate buffer (pH:7,4) and stained in 2 % osmium tetroxide. Cells were embedded in EPON 812 . Thin sectioned using a diamond knife to thickness of 100 nm. The sections were stained with lead citrate and uranyl acetate. Electron micrographs shows intact cells after selenite reduction and large amaounts of selenium-containing particles are present in the culture medium indicating that strain 106 is able to efficiently transport elemental selenium out of the cell. [Poster]

TIMING FOR THE EVOLUTION OF SALT LAKES IN THE QAIDAM BASIN, NORTHWESTERN CHINA

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The salt lake/playa in the Qaidam basin in the northeastern Tibetan Plateau formed in response to palaeoclimatic changes. When climate shifted from warm-humid to cold-dry conditions, the fresh-water lake shrank, gradually leading to the formation of salt lake/playa. Lacustrine deposits of the Qaidam basin contain the full record of climatic changes. Aeolian activity occurred due to exposure of vast lacustrine deposits. Constrained chronology plays a key role in understanding the evolution of salt lakes and understanding the driving forces of dramatic change in both climate and environment. The timing of lacustrine and aeolian sediments in the Qaidam basin will enhance our understanding of environmental changes. Recently, we have undertaken a multi-disciplinary project which aims: (a) to reconstruct the palaeoenvironment in the Qaidam basin; (b) to better understand the timing of the salt lake evolution and its relationship with the climatic change; and (c) to understand the timing of the human habitation/migration to the Tibetan Plateau. We will report results of the on-going project, including progress to constrain lake chronology using luminescence dating. [Session 5]

PREDICTION OF THE SOLUBILITY OF HCl-MgCl2-H2O SYSTEM AT -5°C USING THE ION-INTERACTION MODEL

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The component solubilities of the HCl-$MgCl_2$-H_2O system at -5°C were predicted by using Pitzer's ion interaction model and its extended Harvie and Weare model. The results indicated that the model supplies a good prediction of the above-mentioned system. The values of parameters of ß (0), ß (1) and Cf of HCl and $MgCl_2$ were obtained by using the same optimization methods as the literature, while those of MgH_2 and MgHCl were derived by extrapolating the literature data of 5°C, 15°C, 25°C, 35°C and 45°C, as well as coupling the activity coefficients with the solubility data. The comparison between the calculated results and the experimental data indicated that the Pitzer's ion interaction model and it's extended Harvie and Weare model are quite reliable in the solubility prediction. [Session 7]

THE ROLE OF THE PHYTOPLANKTERS IN FORMING THE SEDIMENTS FROM THE LAKES WITH PELOGENOUS POTENTIAL

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Based on the contribution of the vegetal material in forming the sediments from pelogenous lakes, in the years 1983-2005 the micro- and macrophyte populations from Salt Lake Braila, Fundata Lake, Techirghiol Lake and Amara Lake with different physico-chemical characteristics were studied, following the presence and the distribution of those in lenthic facies and the structure of the phytoplankton communities. After the identification of the phytoplankton species and the determination of their abundance, it has been observed that the following hydrobiota may have an important role in the productivity of those lakes with pelogenous potential: the filamentous algae *Cladophora crystallina*, *Enteromorpha clathrata*, *Spirogyra tenuissima*, *Ulotrix zonata*, *Rhizoclonium hieroglyphicum*, as important organic substance donors in the *Techirghiol*, *Fundata* and Salt Lakes; the submerged macrophytes Potamogeton pectinatus, Myriophyllum spicatum, representing the major source of organic substance in Fundata and Amara Lakes; the emerged macrophytic vegetation *Phragmites communis*, *Typha angustifolia*, which are important in the economy of the therapeutical lakes from Amara and Fundata; and the microalgae (cyanobacteria, diatoms, *euglenophyta*) that have represented a smaller but constant infusion of organic substance in the peloidogenesis process from all four studied lakes. [Poster]

OVERVIEW OF THE MICROBIAL DIVERSITY IN GREAT SALT LAKE: RESULTS USING BOTH CULTIVATION AND MOLECULAR TECHNIQUES

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For four years, water samples from Rozel Point near the artwork Spiral Jetty were subjected to cultivation, carbon and nitrogen utilization tests, and molecular analyses using Length Heterogeneity PCR, cloning, and sequencing of the 16S rRNA genes. There were significant changes in the haloarchaeal community composition, but throughout, the halobacteria were dominated by *Salinibacter*. During the first two years, six haloarchaeal groups were represented, while the last two years the diversity increased to 10 and 9 groups. BIOLOG phenotypic carbon 1 and nitrogen 3 plates estimated the metabolic versatility of the whole community. There was little overlap in the carbon and nitrogen sources used. Twelve haloarchaea were isolated from wells and identified as *Halorubrum* and uncultivated NaxosII. Over 50 isolates were obtained from the plate enumerations including the genera *Salinibacter*, *Halomonas*, *Halorubrum*, *Halobacterium*, and *Haloarcula*. Thus, the microbial community of the North Arm is dynamic and is undoubtedly responding to the various nutrient inputs from the brine flies, brine shrimp, migratory bird populations as well as the local temperatures and fresh water and oil seeps found throughout the North Arm. [Session 1]

THE STUDY ON MINERALIZATION OF DANGXIONG CO LARGE LI-B DEPOSIT, TIBET, CHINA

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The Dangxiong Co Saline Lake located in the hinterland of Tibet plateau, is a large-scale bittern Li-B deposit. Due to northward continuous extrusion of Indian plate, a transmeridional outward spreading occurred in the inner part of Tibet plateau, a rift valley formed in Miocene near the south end of Dangxiong Co—Dangreyong Co—Xuru Co. The Dangxiong Co—Dangreyong Co—Xuru Co lake basin was part of the “Panlake” of Tibet plateau and completely covered with water. 30,000 years before present, the paleo-climate of Quaternary changed from a wet regime in early-medium Pleistocene-to dry-cold regime at the end of late Pleistocene. The Dangxiong Co—Dangreyong Co—Xuru Co lake basin was separated from the “Panlake” and became three independent lakes. In the course of 20,000 to 30,000 years, minerals accumulated in lake water ranging from the high-level lake (Xuru Co) and the middle-level lake (Dangreyong Co) to Dangxiong Co (low-level lake) by the action of evaporation-chemical differentiation and precipitation. Notably, the Li and B concentrations in rivers and springs (especially the thermal springs) within drainage basin of Dangxiong Co are about 100 times of average concentration of other world rivers. [Poster]

PHYSICAL-CHEMICAL CHARACTERISTICS OF LAKE UVS, MONGOLIA

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Lake Uvs is one of the remains of an ancient inland great sea covering the present Great Lake Deposition and Value of Lakes. In ancient times this lake was a last accumulative basis receiving different kind of sediments from rivers and sairs non permanent riverbed from it’s huge catchment area 71100. Most of that is layed in arid and semi arid condition. Considered on long –term fluctuation of main humidity of the Basin using precipitation data and determined main tendency of arid and humid periods which are effect considerably in changing the Uvs lake level. The watershed reaches from an altitude of 759 m up to 4037 m. It includes sandy, stony and semi-deserts, sand dunes, mountains and forest steppes, Larix-forists, alpine areas and glaciers, swamps and different rivers and lakes. Standing waters Origin Basin Max.depth; tectonic, shallow, 23 Water renewal time; -15 Altitude/thermal type; 761, dimictic Max.surface temp./Annual degree days; max.20, 2200 Wat.type, pH, Conductivity/Transparency; hyposaline, 9.0, 19000, high6.0 NUTRIENTS;TN/Total.Phosph./SRP; 0.3-2.1, 0.021-0.084, <0.01 Fish/Zooplankton/Phytoplankton; Oreoleuciscus, Arctodiaptomus, Planktolyngbya Transparency/m/ ; 6/NW/, 0.3 /E/ O2 saturat.epilimn. 100% O2 saturat. Hypolim. ; 70-80 % pH epilimnion ; 9 pH hypolimnion; 9 total P ; 18 (NW) , 84 (E). (sic) [Poster]

PARTICULATE C, N AND P DYNAMICS IN THE DEEP TROPICAL LAKE ALCHICHICA

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Particulate Organic Carbon (POC) and chlorophyll "a" dynamics during 2005 and 2006 confirmed the recurrence of three main patterns of phytoplankton development along the annual cycle at Lake Alchichica. A large diatom bloom takes place during the winter mixing. A cyanobacterial bloom develops at the onset of the stratification. Finally, a deep chlorophyll maximum reaches its largest concentration peak during late stratification. Particulate Organic Nitrogen (PON) showed that during the 2005 cyanobacterial bloom, nitrogen fixation was important (13.47 ±1.20 µmol L-1). In contrast, in 2006 even though POC reached a similar concentration (68.33 ±10.14 and 71.25 ±8.33 µmol L-1 in 2005 and 2006), PON indicated nitrogen fixation by cyanobacteria was minimal (3.82 0.± 57 µmol L-1). Particulate Organic Phosphorous (POP) values (0.68 ±0.09, 0.34 ±0.06 µmol L-1 in 2005 and 2006) suggested that the intensity of nitrogen fixation was inversely related to phosphorous limitation (N:P = 20 and N:P = 11.5 in 2005 and 2006). Stoichiometric ratios (C:N:P) of suspended particulate matter also exhibited significant variations that suggest alternation of the limiting nutrient of phytoplankton growth at this saline lake. [Poster]

DUNALIELLA TRAPPED IN FLUID INCLUSIONS IN MODERN AND ANCIENT (?) HALITE, DEATH VALLEY AND SALINE VALLEY, CALIFORNIA

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Possible Dunaliella cells, 4-15 µm in size, occur in fluid inclusions in 22,000-100,000 year old halite from a Death Valley salt core. Dunaliella are also found in fluid inclusions in halite collected in 2005 from Saline Valley, CA, and were successfully cultured from dissolved samples of this halite. Dunaliella trapped in fluid inclusions in laboratory grown halite are typically green and pear-shaped; some remained motile for several weeks. Algal morphologies resembling Dunaliella occur in fluid inclusions in halite from a 90-m long, well dated (100,000 year old), salt core from Death Valley, CA; attempts to amplify DNA from these samples using PCR have so far been unsuccessful. These possible Dunaliella cells are most abundant in clear primary halite that originally crystallized at the bottom of a perennial saline lake 22,000-31,000 years ago. Ancient halophilic Archaea and halotolerant Bacteria were cultured from the same core depths that contained Dunaliella. If algae and bacteria are trapped in the same fluid inclusions, glycerol from Dunaliella may provide the nutrients needed by trapped microorganisms to survive for tens of thousands of years. [Session 1]

DEVELOPMENT AND UTILIZATION OF BRINE WITH HIGH QUALITY BISCHOFITE AND OTHER ELEMENTS AFTER THE EXTRACTION OF POTASSIUM FROM A SALT LAKE IN CHINA

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The production of potassium chloride in Charhan, a salt lake located in Qinghai Province, China, has reached well over 2.50 million tons per year. These operations produce more than 60 million cubic meters (m3) of byproduct brine containing high quality bischofite and other rare minerals that are transferred and stored in adjoining basins. At present these brines are untreated. As more bischofite brine is produced, it overflows to the original brine source, posing a threat to the balance of the brine system, affecting brine quality and future production of potash. The author gives an introduction as well as analysis of the history and status quo of developing useful products from the bischofite resources from salt lakes in China including: flame-resisting materials, metallic magnesium and related alloys, chemical materials and magnesium cement. The author also discusses the most effective ways and paths of magnesium resource development as well as utilization of other elements from salt lakes in China in future. [Session 7]

A POPULATION-SPECIFIC MARKER WITHIN THE SUPERSPECIES ARTEMIA FRANCISCANA

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Studies on biodiversity utilizing molecular tools range from barcoding to stock assessment hold great promise for future advances in both basic and applied research. In this work we present the results of a screening program of Artemia franciscana populations based on the size of the second p26 gene intron. This molecular marker has been assessed in reference material from the San Francisco Bay (SFB) and Great Salt Lake (GSL) Artemia stocks and a preliminary survey has shown that it is specific at the population level. PCR amplification of this region in SFB yielded a fragment of ~1500bp in length while in GSL two patterns were obtained, namely ~2000bp and 2000/1500bp. We confirmed the population-specific nature of this marker by an analysis of hundreds of specimens as well as by crosses of individuals from the respective populations. Artemia from South America and feral populations worldwide, traditionally grouped with the SFB material, also showed the expected 1500bp genotype. These patterns may provide a diagnostic tool for population assignment and contribute to diversity assays within the A. franciscana complex. [Poster]

INTERMOUNTAIN WEST AQUATIC BIRD SURVEY

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Monitoring programs – whether long-term to assess status and trends or short-term, conducted as part of a management program – play a key role in avian conservation. Despite the importance of rigorous monitoring programs, many efforts at present are incomplete and uncoordinated and are thus of less value to managers than they might be. For example, hundreds of surveys of aquatic birds are made every year in the intermountain west. Yet most of the data collected are not contributed to any central repository and many of the data sets are being lost each year. Furthermore, in the past no comprehensive design declaring goals, objectives, and methods has existed. As a result, even if the data collected could be assembled in one place, it would be difficult to produce regional estimates of distribution, abundance, trends, or to address specific management issues. The Intermountain West Coordinated Bird Monitoring Project is designed to increase the efficiency of bird monitoring efforts in the intermountain west through improved coordination. Participants include most of the States, federal agencies, and bird observatories in the Intermountain West. [Session 10]

SELENIUM IN WATER, SESTON, AND ARTEMIA FROM THE GREAT SALT LAKE, UTAH FROM APRIL 2006 TO AUGUST 2007

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A field study of the pelagic zone of the Great Salt Lake, Utah (GSL) was conducted from April 2006 through August 2007 to document selenium concentrations in GSL water, seston, and the dominant zooplankton – brine shrimp (Artemia franciscana). Population dynamics of brine shrimp were well within the boundaries of previously reported population cycles on the GSL. The dissolved selenium concentration in water had a geometric mean of 0.52 ug/l and the total selenium concentration in water (particulate and dissolved) had a geometric mean of 0.61 ug/l. The concentration of selenium in the particulate fraction (seston) showed a geometric mean of 0.92 ug/g. Brine shrimp were divided in to age-classes prior to selenium analysis. The geometric mean selenium concentration in adult brine shrimp during 2007 was 4.22 ug/g and for the nauplii it was 2.25 ug/g. The partition coefficient (Kd) for dissolved selenium in the water (ppm) to seston (ppm) was in the range of 1845 to 2228. Transfer factors of selenium from seston to adult brine shrimp were in the range of 1.46 to 5.95. [Session 8]

AN ADAPTIVE MANAGEMENT APPROACH TO OPTIMIZING WETLAND HABITAT FOR BIRDS ALONG THE SHORE OF GREAT SALT LAKE

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The Great Salt Lake Ecosystem contains a complex mosaic of aquatic habitats controlled primarily by lake level and the amount and timing of seasonal precipitation and snowmelt. Significant restoration work has been done on reinstating "natural" hydrologic regimes in wetland systems. Using an adaptive management approach, our goals are to optimize wetland quality and function through mimicking natural cycles of flooding and drawdown. We are analyzing the effects of water management on vegetation and birds in shallow playas, wet meadows, and grassland ponds within saline wetlands historically inundated by Great Salt Lake. We developed a bathymetry model for an area within the historic river delta where the Jordan River flows into Farmington Bay in Davis County, Utah. Water timing and amount have been controlled to optimize habitat for nesting and migratory shorebirds and other water-associated birds. Through study of drawdown duration and other factors such as soil salinity, we have developed a management strategy to maintain soil salinity at appropriate levels to accomplish specific habitat goals and objectives. [Session 10]

COMMUNITY METABOLISM AND DIEL VARIABILITY IN AFRICAN SODA LAKES

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Community metabolism based on time-series measurements of dissolved gases integrates ecosystem processes and is receiving increased attention among ecologists. As part of a comparative study of tropical saline lakes, community metabolism was measured in two contrasting Kenyan soda lakes based on a series of vertical profiles of dissolved oxygen and temperature over several diel cycles each month during a 15-month period. Variations in areal oxygen content at successive intervals throughout each day and night were corrected for air-water oxygen exchange to calculate net free water oxygen change. Maximal rates of increase usually occurred in late morning or early afternoon; maximal rates of decrease were common at sunset. Free water estimates of photosynthesis usually exceeded rates measured in bottled samples. Information theory based indices of predictability were used to quantify seasonal differences in diel variability of dissolved oxygen and temperature. Diel temperature cycles in large, shallow Lake Elmenteita were slightly more predictable than those in small, deep Lake Sonachi. Diel dissolved oxygen cycles in the near surface waters had the same predictability in both lakes. [Session 6]

THE RESEARCH ON DISTRIBUTIONS OF THE OTHER ELEMENTS IN QARHAN POTASH FERTILIZER PRODUCTION PROCESS

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In the potash fertilizer production process, the content of Li+ increases constantly with the concentration of brine. Lithium reaches its maximum concentration in the final stage of carnallite crystallization, and more than 60% of the Li+ remains in the liquid phase. The boron content also increases with the concentration of brine in the sodium chloride crystallization zone. However, boron content remains largely keeps mostly unchanged after carnallite crystallization zone, about 50%. The maximum concentration of rubidium (Rb+) in the liquid phase appears in the sodium chloride crystallization zone area. This value then declines sharply when the brine reaches carnallite crystallization zone. At the same time the rubidium content in the solid phase increases dramatically, and the average content of rubidium in the solid phase is as high as 40 mg/l. The cesium content in the brine is rather low, which is below 0.2 mg / l in the liquid phase and below 1 mg/l in the solid phase. Its value is almost the same in the sodium chloride area and in the carnallite zone. [Poster]

ECOLOGICAL BALANCE OF RE-CREATED SHALLOW WATER WETLANDS, SALTON SEA, CALIFORNIA

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Chemical, nutrient, and contaminant patterns were monitored relative to water and sediment dynamics, invertebrate community succession, and post-hatch survival of nesting birds at four wetlands cells created in 2006 and reference sites, southern Salton Sea, California. Before the cells were flooded with waters from the Alamo River and Salton Sea, the soils were ~ 50 % silt, and 25 % each sand and clay, and soil chemistry resembled that of nearby wetlands. DDE was the only organic contaminant detected in sediments at the cells and reference sites. After flood-up, salinity (> 150 g/l in cell 4) and certain elements were elevated in water in some cells. Corixids colonized rapidly along with aquatic birds. Selenium (Se) in Corixids initially averaged 6.0 ug/g (geometric mean, dw) at the cells and 1.8 ug/g at reference sites but has since declined. In eggs of black-necked stilts that nested at the cells, geometric mean Se =5 .8 ug/g and DDE = 7.9 ug/g (dw), whereas Se = 5.3 and DDE = 4.1 ug/g in eggs from reference sites. [Session 3]

USE OF MACROINVERTEBRATES TO DESCRIBE WETLAND CONDITION AND BENEFICIAL USE SUPPORT IN GREAT SALT LAKE WETLANDS

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Support for waterfowl and shorebirds and the aquatic life in their food chain is one of the beneficial uses identified for Great Salt Lake and its lacustrine wetlands. As such, there is notable concern as to whether nutrient-enriched tributaries and POTW discharges are impairing this important beneficial use. We collected macroinvertebrate samples along hydrologic and nutrient gradients in reference and targeted nutrient-enriched longitudinal transects. Typical tolerant taxa dominated targeted sites as compared to reference sites. However, stomach contents of American avocets and black necked stilts indicated that these tolerant taxa often dominated their diet. This has created a dilemma and a potential contradiction of Clean Water Act goals. [Session 3]

ALGAL AND CYANOBACTERIA SALINE BIOFILMS AT THE COASTAL GRANDE LAGOON FROM LIMA, PERU

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Tropical coastal wetland ecosystems are widely distributed in arid regions. Grande lagoon at Peruís central plain, is shallow, eutrophic and alkaline, exposed to the annual hydrological regime with flooding and desiccation periods with saline crust formation. Brackish to hypersaline habitats showed salinity gradients of 2 - 90 ppt (NaCl) to saturated, pH of 7,3 ñ 9, temperature from 18 to 31∞C, phosphate up to 50 mg/l and nitrate up to 0,88 mg/l. Dominance of benthic cyanobacterial halophilic biofilms and the submerged macrophytes Chara sp. and Ruppia maritima during the clear water state supported the alternative stable states for this lagoon. Cyanobacterial spatial arrangement showed the slime cohesiveness layer mainly formed by Chroococcus turgidus, C. giganteus, Aphanothece stagnina, Lyngbya martensiana, L. diguetti, L. aestuarii associated with Chara sp., Rhizoclonium hieroglyphicum, Aphanizomenon flos-aquae akinetes and Tetraselmis contracta cysts. Cyanobacterial biofilms flourished at the lagoon bed under the halophilic Salicornia fruticosa, Sesuvium portulacastrum and Baccopa monnieri. Species adaptative strategies included a biomass allocation strategy (extracellular matrix) and reproductive strategy complexity for their successful colonization. [Poster]

PHENOTYPIC AND GENOTYPIC PROPERTIES OF BACTERIA ISOLATED FROM TUZ LAKE, TURKEY

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Tuz Lake is one of the greatest salt lakes in the world. It is located in the middle of Anatolia-Turkey. In this study 9 isolates were isolated from this lake by using Sea water agar, a selective medium. These isolates were examined for Archaeal/Bacterial diversity by using 16S PCR techniques and they all gave specific bands with Bacteria-specific universal primers. Pulse Field Gel Electrophoresis was used to compare their genomes by using Xba I macrorestriction enzyme. Fatty acid profiles of these bacterial isolates of Tuz Lake were determined by Gas Chromotography. Whole-cell protein profiles of these isolates were obtained by SDS-PAGE. These 9 isolates were found to be very similar to each other in terms of their phenotypic and genotypic properties. [Poster]

SOURCES AND GEOCHEMICAL CYCLING OF SELENIUM, GREAT SALT LAKE, UTAH

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Sources and geochemical cycling of Se in Great Salt Lake (GSL) were evaluated to better understand current and future impacts of Se on lake ecology. Modeled annual Se load to GSL from riverine inputs was 1,500 kg. The Se concentration in water samples collected from four monitoring sites within GSL showed a statistically significant ($p < 0.10$) upward trend in Se concentration over the 15-month study. Regression models for each lake monitoring site indicated a net increase in Se concentration that ranged from 0.16 to 0.34 ug/L during the study. The modeled net increase expected from measured riverine Se influx (without accounting for sedimentation and gas losses) over the same monitoring period was 0.17 ug/L, indicating unmeasured Se sources contributing a minimum of 1500 kg. One potential unmeasured Se source is submarine groundwater discharge. Continuous resistivity profiles in the southern portions of GSL indicated areas of potential submarine groundwater discharge near fault structures beneath the lake. Previous work has found elevated (> 10,000 ug/L) Se in groundwater < 2 km inland from the south shore of GSL. [Session 8]

THE GOOD, THE BAD, AND THE BEAUTIFUL. TEN YEARS OF AVIAN HABITAT MITIGATION MANAGEMENT NEAR GREAT SALT LAKE UTAH

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In 1995 we identified nesting, migratory shorebirds and waterfowl as key elements requiring wetland mitigation due to impacts from expansion of mine tailings. Our theory was if we increased the food base, allowing fluctuating water levels in the playas throughout the migratory/nesting season, shorebird use would increase. Site modifications made in 1997 were minimal: gravity fed water delivery system and dikes on 2,500 acres, also the use of natural playa topography. State of site in 2007: bird species and numbers increased from baseline; ground predators have self-regulated; monitoring of birds, water, macroinvertebrates, soils, and vegetation collected from 1995-2002; cleaned up tons of human debris; trespass dramatically reduced; used chemistry of salt in wet/dry soils to help control phragmites expansion. Some maintenance issues harder than anticipated: ditch clearing; cessation of grazing increased weedy species; some water availability/quality threats; monitoring high saline systems difficult and expensive; avian predators increased because of artificial structures; potential for adjacent residential/commercial development. Indirect benefits include: educational tool for community, community awareness, improved public relations, ecological community support, surrounding shoreline was protected and upland species were protected. [Session 3]

LANDSCAPE-LEVEL WETLAND CONSERVATION: DEVELOPMENT OF A SPECIAL AREA MANAGEMENT PLAN ON THE SHORES OF THE GREAT SALT LAKE

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Special Area Management Plans (SAMP) can protect large expanses of wetlands and the variety of ecological services they provide, while also allowing for economic development. Fundamentally, a SAMP must be based on sound ecological information about the wetlands and related natural resources within the watershed. One means of providing this scientific basis is to measure the relative ecological functionality. This valuation is important in being able to objectively identify appropriate areas for development, mitigation, and conservation within the planning area. Working within a 70,000-acre study area on the southwest shore of the Great Salt Lake, researchers divided the area into individual wetland functional units and applied a landscape-level functional assessment model to quantify the level of 1) disturbance or degradation to a unit's hydrology 2) disturbance or degradation to a unit's ability to improve water quality 3) the unit's potential to provide wildlife habitat support. The wetlands mapping and functional assessment model results allowed stakeholders to prioritize resources of high value, designate an impact avoidance zone and develop mitigation strategies and ratios for use in future 404 permitting. [Session 3]

CRYSTALLIZATION PATH OF SALTS FROM BRINE IN ZABUYE SALT LAKE, TIBET, DURING ISOTHERMAL EVAPORATION

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The carbonate-based salts of Tibet's Zabuye Salt Lake, are high in Li, B, K and other useful trace elements, and constitute valuable exploitable resources. The beneficiation of elements and the crystallization path of salts in the brine were studied at 15oC and 25oC respectively, based on the isothermal evaporation experiments at the two temperatures. Results show that the crystallization sequence of the primary salts from the brine, i.e. halite (NaCl), aphthitalite (3K2SO4•Na2SO4), sylvite (KCl), trona (Na2CO3•NaHCO3•2H2O) and thermonatrite (Na2CO3•H2O), is generally in accordance with the metastable phase diagram of Na+, K+//Cl-, CO3-2, SO4-2--H2O quinary system at 25oC. The exceptions are the replacement of the Na2CO3•7H2O phase region by the trona and thermonatrite phase regions, and the slight difference in the sizes of the two phase regions. In the 25oC experiment, zabuyelite (Li2CO3) was precipitated in the early stage because the Li2CO3 was supersaturated in the brine, as is in contrast with the late precipitation in the 15oC experiment. Potash was precipitated in the middle stage in both experiments, while boron was enriched in the early and middle stages and precipitated in the late stage. [Poster]

ISOLATION AND CHARACTERIZATION OF CHITIN-UTILIZING HALOPHILES FROM THE GREAT SALT LAKE, UTAH

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The Great Salt Lake's south arm contains a large biomass of brine flies and brine shrimp whose husks and exoskeletons are composed of chitin. Samples from Bridger Bay were inoculated into enrichment flasks containing a carbon-free halophile medium amended with 2.5 g l-1 chitin and incubated at 22oC in a shaker for 3 wk. The biofilm that developed in the flasks was used to inoculate a selective chitin agar. Most of the 14 isolates were obtained from exoskeleton debris collected along the shoreline. Isolates were either Gram-negative rods or cocci with half displaying pigmentation. Based on their 16S rRNA gene sequences, the isolates were related to common halophilic organisms including Gram-negative Halomonas sp. and Salinivibrio costicola, and Gram-positive Marinococcus sp., Bacillus baekryungensis, Salinicoccus roseus and Brachybacterium sp. A fluorescent assay was used to identify chitinase activity and 11 of the 14 isolates demonstrated chitinolytic activity. This is the first survey of chitin-degrading organisms in this hypersaline environment. Chitin decomposition appears vital to the cycling of C and N in this ecosystem so understanding how halophilic bacteria participate is important. [Session 1]

DEVELOPMENT OF A SITE-SPECIFIC STANDARD FOR SELENIUM IN OPEN WATERS OF GREAT SALT LAKE, UTAH

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Great Salt Lake (GSL) is a unique terminal lake located adjacent to Salt Lake City, Utah. Beneficial uses of GSL are protected through application of a narrative clause in the state water quality standards. The Utah Division of Water Quality (DWQ) initiated a process in 2004 to develop a site-specific water quality standard for selenium for open waters of GSL in response to specific concerns expressed by the public. The process DWQ initiated included formation of a Stakeholders Steering Committee and a Science Panel to identify the required studies, manage those studies, and recommend a site-specific standard. Studies were recently completed to assess concentrations and effects of selenium in five species of birds; measure selenium concentrations in water, seston, brine shrimp, and brine flies; measure selenium loads entering GSL; and measure flux of selenium from water through the food web. Information from these studies was used to "populate" the elements of a comprehensive conceptual model for GSL that is being used to establish the site-specific standard for selenium. [Session 8]

INTERANNUAL FLUCTUATION OF THE NITROGEN-FIXING CYANOBACTERIAL BLOOM IN LAKE ALCHICHICA, CENTRAL MEXICO

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Lake Alchichica displays a characteristic cyanobacterial bloom associated with the onset of the stratification period (April-June). It is represented mostly by the nitrogen-fixing cyanobacteria Nodularia cf. spumigena. The intensity and extent of the bloom differs among years. We followed up the bloom along four annual cycles (1999-2002). In 1999 (6,244 cells ml-1) and 2002 (7,927 cells ml-1) the cyanobacterial density showed similar values. In contrast, the 2000 bloom was "weak" with 2,970 cell ml-1, meanwhile in 2001 densities reached up to 104,841 cells ml-1. The blooms lasted from April to August except in 2002 when it began in June and ended in September. Although Nodularia cf. spumigena was found regularly along a three-month period, peak concentrations were reached only for few weeks. In calm weather and solar heating, the Nodularia colonies floated to the lake surface, when the bloom became apparent. Along with the cyanobacterial decay, high concentrations of ammonium and nitrate were released into the water; thus the intensity of the cyanobacteria bloom seemed to influence the nitrogen concentration in the lake. [Poster]

ESTIMATING SELENIUM REMOVAL BY SEDIMENTATION FROM GREAT SALT LAKE, UTAH

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The mass of selenium (Se) deposited annually to sediment in the Great Salt Lake (GSL) was estimated to determine the significance of sedimentation as a permanent removal mechanism. Lake sediment cores were used to delineate qualitative sedimentation regions, estimate mass accumulation rates (MAR), and determine sediment Se concentrations. Sedimentation regions were defined by comparison of isopach contours of Holocene sediment thicknesses to linear sedimentation rates of 20 short cores. MARs were developed via analysis of 210Pb, 226Ra, 7Be, and 137Cs activity in 8 deep cores. These MARs ranged from 0.010 to 0.049 g/cm2/yr. Contemporary sediment Se concentrations from the upper 2 cm of each deep core ranged from 0.79 to 3.12 mg/Kg. Representative MAR and Se concentration were used to develop mean annual Se removal by sedimentation in the corresponding sedimentation region. The spatially integrated Se sedimentation rate was estimated to be 500 Kg/yr within a range of uncertainty between 30 and 1100 Kg/yr. Comparison to annual Se loading and alternate removal processes suggests burial by sedimentation is not the primary removal process for Se from the GSL. [Session 8]

ENVIRONMENTAL GENOMICS STUDIES IN THE DEAD SEA

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The Dead Sea is a dynamic ecosystem in which dense microbial blooms, dominated by Dunaliella and by red halophilic Archaea of the family Halobacteriaceae, develop when the upper water layers become diluted by during exceptionally rainy winters. At other times, conditions are too extreme for microbial activity. Currently only a small community of halophilic Archaea survives in the lake. Sponsored by the Bridging the Rift Foundation, cruises have been held on the lake by Israeli and Jordanian scientists in 2007, and biomass was collected from 5 m depth by tangential filtration. Extracts of this material showed presence of bacterioruberin carotenoids. Amplification of 16S rRNA genes from the biomass yielded genes with less than around 95% identity with environmental sequences reported from other environments and only 89-93% identity with cultivated Halobacteriaceae. Fosmid and BAC clones have been prepared from the extracted DNA, yielding both phylogenetic information (16S rRNA genes) and data on functional genes present in the community. We also have isolated a variety of Archaea and Bacteria from the samples, and their characterization is in progress. [Session 1]

SEASONAL INPUTS OF DISSOLVED AND SEDIMENT-ASSOCIATED PESTICIDES TO THE SALTON SEA, 2006-2007

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The primary sources of fresh water to the Salton Sea are the Alamo and New rivers which drain the Imperial Valley, a region of intensive, year-round agriculture. During a recent study conducted by the U.S. Geological Survey, forty-one pesticides were detected in water and suspended sediment samples collected from these rivers. Over one million kilograms of pesticides (excluding sulfur), were applied in the Imperial Valley in 2006. Pesticide applications followed a bimodal pattern with peaks in the spring and fall; therefore, samples were collected during these seasons. Dissolved pesticide concentrations were detected as high as 8,940 ng/L (EPTC). The most frequently detected compounds were chlorpyrifos, DCPA, EPTC, and trifluralin. Concentrations of pesticides in suspended sediments were detected at up to 174 µg/kg dry weight (pendimethalin). The most frequently detected pesticides in suspended sediment samples were p,p-DDD, p,p-DDE, chlorpyrifos, permethrin, tetraconazole, and trifluralin. The maximum concentrations of most pesticides and the greatest numbers of pesticides were detected in samples from the Alamo River. Maximum dissolved concentrations of carbofuran, chlorpyrifos, diazinon, and malathion exceeded aquatic life benchmarks established by the U.S. Environmental Protection Agency. [Poster]

EXPORT OF BIOGENIC CARBON IN A TROPICAL SALINE LAKE DOMINATED BY LARGE PHYTOPLANKTON

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The flux of particulate organic carbon (POC) was measured at three levels in the water column throughout one year in saline Lake Alchichica. The POC flux ranged from 65 to 451 mg m-2 d-1. Similar values have been reported in comparable oligotrophic lakes. The POC flux values were 223 in the mixed layer, 182 below the thermocline and 206 mg m-2 d-1 at hypolimnion. Seasonal changes of POC flux were recorded with largest values during the circulation season, characterized by a large diatom bloom (Cyclotella alchichicana). The input to the lake floor is herein attributed to a rapid sinking rate of the diatom. The stratification season was characterized by low POC flux in the mixing zone and high flux in the below the thermocline and above the bottom traps. This is explaining by the shifting of the eutrophic zone from the mixing zone to the metalimnion with the developed of a deep chlorophyll maximum. The phytoplankton was the main component of the settling material captured in the sediment traps, explaining the dynamics of the COP, chlorophyll “a” and seston fluxes behave alike. [Poster]

EFFECT OF OSMOTIC DOWNSHOCK TREATMENT ON THE YIELD OF ECTIONE SYNTHESIZED BY HALOMONAS SP. EG6

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Halophilic bacterium, strain EG6, was isolated from Burg el Arab solar saltern lake in Alexandria, Egypt. Strain EG6 can grow in up to 4 M NaCl. Phylogenetic position was established by 16S rDNA gene sequencing as a member of the genus Halomonas. We found out that strain EG6 showed diverse action toward synthesis and release of ectoine during osmotic downshock treatment from 2 M to 0-0.7 M NaCl concentrations. It was interesting to note that strain EG6 had a great flexibility to withstand the sudden change in salinity. Strain EG6 showed the highest total yield of ectoine released with high purity, 3.70 g/L, after 7 days of osmotic downshock from 2 M to 0.3 M NaCl, while type strain Halomonas elongata IFO15536 had lower total yield of ectoine released 2.89 g/L under the same conditions. Significant difference in the amount of ectoine synthesized and released by both strains was found. Furthermore, growth of strain EG6 was highly stimulated in comparison with H. elongata IFO15536 during present downshock treatment. [Session 1]

NUMERICAL MODELLING OF CIRCULATION IN A TROPICAL LAGOON: A CASE STUDY IN CHILIKA LAGOON, EAST COAST OF INDIA

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The Chilika Lagoon (N 190 28'-190 54'; E 850 06'-850 35') on the east coast of India is the largest lagoonal system in the subcontinent and is one of the largest tropical lagoons in the world. Sedimentation, both from riverine discharge and disintegration of macrophytes, choking of the outer channel, shifting of the inlet mouth, decline in water area and increase in vegetated area, and the opening of the artificial inlet mouth are the dominant processes influencing the cotemporary phase of lagoon transformation in the Chilika. Numerical modeling of circulation patterns using the Mike 21 Flexible Mesh Model shows that bottom topography, besides wind and tides forces, plays an important role in determining circulation patterns in the Lagoon which has been validated by observations and is also confirmed because of two results from the model, (i) ebb current is always stronger than flood irrespective of the seasons, and (ii) formation of eddies in the central and the northern sectors of the lagoon. Coupling of an ecological component (EcoLab) with the Hydrodynamic model presents the significant characteristics of water quality in relation to the ecosystem. [Session 2]

EVIDENCE OF AUTOTROPHIC AMMONIA OXIDATION IN THE HYPERSALINE NORTH ARM OF THE GREAT SALT LAKE

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Hypersaline environments are particularly hostile to chemolithotrophs; energetic constraints – due to the large amount of energy expended in osmoregulation and the low energy yield from dissimilatory metabolism – preclude processes such as autotrophic nitrification. In a metagenomic survey of the microbial ecology of the North Arm of the Great Salt Lake (NaCl >280 g l-1) using phylogenetic arrays, functional gene arrays, and metabolite analysis, we detected evidence of ammonia oxidation in all three data sets (organism, gene, and metabolite). The phylogenetic array indicated the presence of Nitrosospira, an ammonia-oxidizing bacterium. The functional gene array detected an amoA gene corresponding to an uncultured ammonia-oxidizing bacterium. Using mass spectrometry we also detected metabolites such as nitrite, hydroxylamine, amino acids, numerous amines, and metabolic co-factors used in nitrogen cycling. The discovery of this physiological group in hypersaline environments suggests a revision of strategies and energetic models used by these microorganisms to cope with salt stress. [Session 1]

MERCURY AND SULFUR CYCLING IN THE GREAT SALT LAKE

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Methylmercury (MeHg), the most toxic form of mercury in the environment, is converted from inorganic mercury by sulfate-reducing bacteria. Previous studies show an inverse relationship between salinity and mercury methylation; consequently, methylation studies are mostly restricted to freshwater sediments. The Great Salt Lake (GSL) has an extremely high sulfate concentration (20 g/L), as well as elevated mercury (0.1 µM). We hypothesized that despite previous reports, high levels of sulfate and mercury contribute to active mercury methylation within these hypersaline anaerobic sediments. We used functional gene arrays, phylogenetic arrays, and environmental measurements (i.e. metabolites and volatile sulfur compounds) to model sulfur and mercury cycling within the GSL. We found a diverse group of sulfate-reducing genes and a range of sulfur metabolites at multiple locations within the lake coincide with extreme MeHg concentrations (21-33 ng/L). Genes involved in mercury resistance and biodegradation of MeHg correlated with lower concentrations of inorganic and methylmercury (r2=0.81). These data indicate mercury biodegradation genes with unprecedented efficiency within the GSL and represents an untapped resource of genetic diversity that can provide new mechanisms to detoxify MeHg-contaminated sites. [Session 11]

DISTRIBUTION OF WOODY DECOMPOSER FUNGI WITHIN THE GREAT SALT LAKE

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Fungi play important roles in the decomposition and recycling of plant litter, due to their capacity to produce enzymes that digest cellulose and lignin. The Great Salt Lake (GSL) is an extreme saline environment, yet some fungi survive these conditions. The GSL varies in salinity at different locations from a low concentration of 5% to a high of over 30%. Every year coarse woody debris (CWD) is washed into the lake creating a potential substrate for fungi. I studied the differential dominance of decomposing fungal species within areas of differing salinities. I collected CWD from six areas of the lake with differing salinities. I then plated the samples on agar with water collected at the site. Plates were incubated for two months. Filamentous fungal growth only occurred on two areas. After the two month period I replated half the samples onto agar with 5% salinity to observe possible dormancy effects. Results suggest that areas of lower salinity allowed for a greater diversity of filamentous fungi than that of the higher salinities. Areas near salt saturation showed no filamentous fungal growth. [Poster]

LINKING COMMUNITIES, WETLANDS AND MIGRATORY BIRDS; AN EXPERIMENT IN SALT LAKE BIRD CONSERVATION

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The Western Hemisphere Shorebird Reserve Network (WHSRN) program was developed and put in place to conserve shorebird stopover sites. In 1998 three of these WHSRN sites that share the same species of shorebirds along the migratory pathway were networked through a conservation linkage. These sites are the Chaplin Lake area of Saskatchewan, the Great Salt Lake of Utah and the Marismas Nacionales complex of Nayarit. Each of these WHSRN sites is dominated or influenced by saline habitats. The program is known as the Linking Communities, Wetlands and Migratory Birds Program (Linking). Since its inception Linking has worked through local partnerships in the three countries to carry out conservation activities. The primary emphases have been on shared formal and informal education, developing ecotourism partnerships and collective science and habitat conservation. As important as the projects to the success of Linking are the working relationships and shared vision of the partners. A broader conservation perspective has developed with new partnerships, but migratory bird conservation remains the primary emphases. [Session 10]

THE PRESENT-DAY CENTRAL CASPIEN SEA PHYTOPLANKTON

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During 2004-2006 the seasonal species succession and phytoplankton species and quantitative structure were examined on the central part of Caspian Sea. It was established that there had been changes in diatoms dominant in the leading complex of phytoplankton species. Instead of traditional large-cell diatom Pseudosolenia calcar-avis, Dactyliosolen fragilissimus, dominating in 60th – 80th years of the last century, new species for Caspian Sea Pseudo-nitzschia seriata, Cerataulina pelagica. Chaetoceros peruvianus prevailed during spring-summer bloom. Our research in the Central Caspian Sea showed the presence of Emiliania huxleyi and Pseudo-nitzschia pseudodelicatissima in plankton phytocenosis. Beside that, new Caspian Sea species dinoflagellates and the coccolithophorid Braarudosphaera bugelowii were found. It was determined that the change in the diatom component of leading phytoplankton complex has lead to the decrease of ecosystem productivity. Despite the fact that during May and October – November the diatom blooms biomass reached 0.15 – 0.2 g C m-3, it was twice as low as the 70th-80th years of the last century when Pseudosolenia calcar-avis dominated. [Session 6]

LAKESIDE LEARNING PROGRAM: USING GSL AS AN OUTDOOR CLASSROOM WITH FRIENDS OF GREAT SALT LAKE

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The Lakeside Learning program is a science education field trip program directed by FRIENDS of Great Salt Lake to 4th grade students in Salt Lake, Davis and Weber Counties. Great Salt Lake provides a perfect outdoor classroom for students to learn about unique plant and animal adaptations in hypersaline habitats, the lake effect weather phenomenon, watersheds and water cycles, food webs, wildlife and avian relationships to Great Salt Lake, and our own human connections to this saline environment. The field trips are designed to complement the 4th grade science core curriculum mandated by the state of Utah. A primary goal for the program is to provide a positive outdoor opportunity for students to understand the importance of the GSL ecosystem to our own local communities, and to frame that understanding within a hemispheric context. [Session 12]

SALT FLAT BASIN'S CONTRIBUTION TO REGIONAL DUST PRODUCTION AND POTENTIAL INFLUENCE ON CAROTENOID BIOSYNTHESIS IN THE HALOPHILIC ALGA DUNALIELLA SALINA TEODORESCO (CHLOROPHYTA)

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Unicellular green alga of the genus Dunaliella are found in abundance in many hyper-saline habitats. Although a number of species were described in the past century, in response to environmental stress only vegetative cells of very few species such as Dunaliella salina will over-accumulate secondary carotenoids in their plastid. In this presentation the current status of research on the unique properties of the carotenoid biosynthesis in D. salina will be summarized. [Session 4]

ROLE OF DRY LAKE BED SALTS IN CLOUD FORMATION

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The overall impacts of aerosol particles on cloud formation and properties represent the largest single source of uncertainty of predicting future climate change. During the Ice in Clouds Experiment – Layer Clouds (ICE-L), the size-resolved chemistry of individual cloud droplets and ice crystals were directly sampled and characterized in real-time using an aircraft aerosol time-of-flight mass spectrometer during flights over Wyoming. During certain wave cloud flights, salt dominated particles with signatures indicative of dry lake bed dust particles dominated the measured cloud nuclei. These salt particles most likely originated in the Great Basin region based on calculated air parcel trajectories for those periods. These findings suggest that the impact of dry lake bed salts could be quite significant globally due to the enhanced cloud-forming ability of these salts, the global abundance of dry lake beds, and increasing potential for dust storms due to warmer climates and future changes in land use. [Poster]

THE EFFECTS OF MINING ON A SALT LAKE IN THE WESTERN AUSTRALIAN GOLDFIELDS

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Lake Carey is a large ephemeral lake of about 750 km2 in the arid Eastern Goldfields of Western Australia. It is one lake in a chain that makes up the Carey Palaeodrainage system, formed during the Tertiary Period, about 65 million years ago. Lake Carey has recently (within the last 10 years) become the focus of interest of a number of mining companies, most of them gold mining companies. There is concern from a number of people that the joint activities of several mining operations may have an impact on the biological functions of the Lake. After ten years of monitoring the Lake, changes both physical and biological have been observed that have a high likelihood of being caused by hyper-saline groundwater dewatering discharge, dewatering drawdown effects, sedimentation or a combination of some or all of these factors. As climatic conditions in the Goldfields are cyclic, biological changes may also be due to natural variations. [Session 11]

CLIMATE AND WATER-LEVEL CHANGE OF ZABUYE SALT LAKE, TIBET

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Zabuye Salt Lake is located in the interior of Tibetan Plateau, which is 4421m a.s.l, at 84º08'E and 31º24'N. In 1990 a field station was established there, and the climate and lake level has been monitored since then. There are nine steps of large-scale sand levees well preserved in the lake basin. The historical precipitation and water salinity corresponding to each step of the sand levees were estimated by studying of the water-energy balance. The precipitation was about 567mm/year at 27.46ka BP corresponding to the highest sand levee, which is 170m above the lake surface, and drops 200 ± 50 mm/yr. to the present condition step by step. Current climate around the lake is characterized by low temperatures (2.0 degrees), low precipitation (~150 mm/yr.) and high evaporation (2514 mm/yr.). The air temperature has risen 1~2 degrees in the past two decades, while the precipitation and lake level have shown synchronous cyclic fluctuation and a certain rise tendency. [Session 13]

APPROACH TO THE ROLE OF PARASITES ON THE SUCCESSFUL INVASION OF MEDITERRANEAN SALTERNS BY THE INVASIVE ARTEMIA FRANCISCANA

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Artemia species play an important role as intermediate hosts of parasite cestodes (Cyclophyllidea), facilitating the parasite transmission to the avian hosts by predation, mediated by an important behaviour manipulation of brine shrimps. When exotic invasive species escape from their coevolved parasites and encounter new parasites in the invaded environment, they can experience a demographic release, becoming highly competitive and an important threat to biodiversity as a pest. This is a report on the presence of American A.franciscana in a Mediterranean saltern where this exotic species eliminated autochthonous ones. To assess whether invasive A.franciscana participates in the cestode presence to the same extent than native Artemia species, we studied the natural infection of A.salina and A.parthenogenetica from not invaded Mediterranean salterns, and parasitized A.franciscana in the invaded saltern. Ten parasite species, mostly hymenolepidids, were found in autochthonous brine shrimp populations. The invasive A.franciscana population showed eight parasite species, mainly dilepidids. Infection quantitative descriptors were markedly higher in the native than in the invasive species. Differences in reproductive output and behaviour manipulation suggest also the invasive success of the alien brine shrimp. [Poster]

GYPSUM PRECIPITATION EVENTS IN THE SALTON SEA: THE ROLE OF MINERAL FORMATION ON OPTICAL PROPERTIES IN A HYPERSALINE LAKE

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Distinctive green water masses have been observed in the Salton Sea and can form over 90+ percent of the lake. Green and non-green waters were optically characterized during one of these events. Temperature, salinity, chlorophyll a concentration, and concentration of colored dissolved organic matter (CDOM) were similar in both water types. Dissolved oxygen was much lower in green water (<0.1 mg/l) than in blue water (<0.4 mg/l). Particulate absorption spectra were similar in both water types and were dominated by phytoplankton. Particulate scatter was approximately twice that of green water. Ratios of backscatter to absorption, backscatter to total scatter, and the slope of the particulate attenuation spectra indicate that small, inorganic particles dominate the particulate fraction of green water. Small (3-5 µm) gypsum particles were detected in green water samples and were most likely the cause of the high light attenuation. Without detailed information on the composition and abundance of these optically important substances, predictions of increased transparency due to expected reductions of phytoplankton biomass via controls on nutrient loading need to be made with caution in the Salton Sea. [Session 2]

MONO BASIN FIELD STATION SUPPORTS SCIENTIFIC RESEARCH AND PUBLIC POLICY AT MONO LAKE, CALIFORNIA, USA

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The Mono Basin Field Station was established in 2004 by the Mono Lake Committee for the purpose of supporting scientific research in the Mono Basin to advise public policy in the region. The Field Station supports scientists and researchers in this remote region of the Sierra Nevada with meeting and office space, bunkhouse accommodation, and communication infrastructure. The Mono Lake Committee is a non-profit citizens group dedicated to protecting and restoring the Mono Basin ecosystem, educating the public about Mono Lake and the impacts on the environment of excessive water use, and promoting cooperative solutions that protect Mono Lake and meet real water needs without transferring environmental problems to other areas. The Committee recognizes that science plays a critical role in forming policy, land management decisions, and stewardship action, and has used science-based information throughout its 30-year history. Research on the results of restoration efforts is particularly important, and projects within the Mono Basin watershed have priority. Information and an application for the Mono Basin Field Station are available online at www.monobasinresearch.org/station/. [Poster]

CRUSTS AND DUSTS AT PLAYAS IN THE MOJAVE DESERT, USA

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Playa type, playa hydrology, and surface-sediment characteristics control the type and amount of dust emitted from playas. Evaporite-rich, soft sediment occurs on the surfaces of some Mojave Desert playas, where the depth to water below the playa surface is <4m (wet playas). Ground-based observations, remotely triggered digital cameras, and satellite (GOES) imaging of Franklin Lake and Soda Lake playas show that evaporite-rich areas are significant sources of atmospheric dust. Wet-playa surfaces vary and commonly include areas of soft, efflorescent salt-rich sediments, areas of puffy clastic sediment with minor interstitial salt, and areas of crusty, stiff salt pans. Spatial and temporal variability of surface characteristics within the evaporite-rich and the puffy areas appears associated with timing and intensity of rainfall events and with vertical fluctuations of the near-surface potentiometric surface. In contrast, dry playas are characterized by deeper groundwater and consequently commonly have hard surfaces that produce little or no dust if undisturbed. Although not a dominant source of global dust, wet playas may be important with respect to radiative properties of dust plumes, atmospheric chemistry, and human health. [Session 5]

SPATIAL USE AND SURVIVAL OF POST-HATCHLING BLACK-NECKED STILT CHICKS IN RE-CREATED SALTON SEA SHALLOW WATER WETLANDS

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Aquatic birds of the Salton Sea face a tenuous future owing to declining freshwater inflow and subsequent loss of shallow water habitat. We studied spatial use and survival of post-hatchling black-necked stilts (Himantopus mexicanus, BNST) in re-created saline habitat ponds (SHP) along the southeastern shoreline of the Salton Sea over 2 consecutive breeding seasons (2006 – 2007). We radio-marked 72 BNST chicks within 1 day of hatching, and compared spatial use and survival of chicks hatched at the SHP to those at a managed freshwater wetland (MFW) in 2007. For SHP chicks, > 68% permanently emigrated from the SHP within < 4 days of hatching, dispersal distances averaged ~1 km, and 41 – 71% (variability dependent upon censoring assumptions) survived to 21 days post hatch. At the MFW, chicks were 4.5 times less likely to emigrate, dispersal distances averaged ~600 m, and 81% survived to 21 days post-hatch. These preliminary results may indicate higher survival and site tenacity for BNST hatched in lower salinity habitats than those hatched in higher salinity. [Session 10]

MOLECULAR IDENTIFICATION OF MICROBES ASSOCIATED WITH THE BRINE SHRIMP ARTEMIA FRANCISCANA.

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We performed 16S rRNA gene sequencing to identify Bacteria and Archaea associated with adult and encysted Artemia embryos from a natural environment - Great Salt Lake (GSL) in Utah. We found that bacterial sequences most similar to the genera Halomonas and Vibrio were commonly extracted from adult GSL Artemia, while bacterial sequences similar to the genera Halomonas, Psychroflexus and Alkalilimnicola dominate in GSL water. Encysted embryos yielded bacterial sequences from the genera Idiomarina and Salinivibrio which were absent from adults and water. Common archaeal sequences from adults were most similar to the genera Haloterrigena and Haloarcula, while all of the archaeal sequences from GSL water are similar to the genus Halogeometricum. Cyst derived archaeal sequences were most similar to the genera Halorubrum and Haloarcula. In addition to microbes that are specific to different stages of the Artemia life cycle, we observed striking differences in the sequences associated with the adult Artemia population in samples collected at different times. Our findings suggest that the microbes may be important during the Artemia life cycle and the GSL food web. [Session 1]

MICROBIAL DIVERSITY AND FUNCTIONAL ECOLOGY OF THE GREAT SALT LAKE

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Because of its hypersalinity, the Great Salt Lake (GSL) represents a unique environment with limited biological diversity. Interest in the GSL has yielded novel bacterial and archaeal isolates, yet the microbial ecology remains poorly understood. We analyzed the phylogenetic and functional diversity of microbial communities in the GSL across a salinity gradient. The microbial diversity was assessed using 16S sequencing and Phylogenetic Arrays (Phylochip) containing probes for 8,741 microbial taxa. Functional diversity was measured using a gene array (GeoChip) containing over 24,000 probes for genes involved in biogeochemical and environmental processes. Samples were collected from the North Arm (30-33% salinity), South Arm (12-15%), and Farmington Bay (4-6%). We identified 100 genera in the North Arm, 333 in the South Arm, and 641 in Farmington Bay, and revealed 4,560 different genes favoring enzymes involved in sulfur cycling, heavy metals, and biodegradation. Interestingly, no clear functional difference was observed between different locations, indicating that common processes occur throughout the lake despite the salinity gradient and microbial diversity. This is the only known assembly of global phylogeny and functional biodiversity for the GSL. [Session 1]

COMPETITIVE EXCLUSION OF CYANOBACTERIA IN THE GREAT SALT LAKE

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Under Gause's principle two species cannot indefinitely occupy the same niche. The north and south arms of Great Salt Lake are separated by a rail causeway, resulting in salinity differences and color variation between the arms. This natural experiment allows examination of competitive exclusion of cyanobacteria in the hypersaline environment of the GSL. Cyanobacterial distributions partially map salinity, with extreme halophiles proliferating in the North. To test if cyanobacterial species are competitively excluded during some seasons from different areas of GSL, 129 flasks of autoclaved water from the north, south and control were inoculated with GSL water samples from the north or south. Initial results indicate that more cyanobacteria species flourish in medium from the south than the north. Only one of the southern species flourishes in medium from the north. This suggests that some northern species are competitively excluded from the southern arm. [Session 6]

PATTERNS OF SEASONAL PHYTOPLANKTON SUCCESSION AND DISTRIBUTION IN PRAIRIE SALINE LAKES OF THE NORTHERN GREAT PLAINS (USA)

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Phytoplankton seasonal succession has been well documented in temperate freshwater lakes, but has not been studied in prairie saline lakes. In order to discern patterns of phytoplankton succession and distribution, we performed seasonal surveys of 19 lakes in the northern Great Plains (U.S.A.) in spring and late summer of 2004. Canonical correspondence analysis was used to determine key environmental parameters controlling phytoplankton distribution. Seasonal nutrient enrichment assays were also performed in 2006 to assess nutrient limitation in natural assemblages (treatments = control, +Fe, +N, +P, +N+P). Diatoms generally dominated the phytoplankton community in the spring, with distribution driven by chloride concentrations and N:P seston ratios. Cyanobacteria tended to be dominant in the summer, and distribution was driven by C:P seston ratios, total Fe, and total N. Experimental results indicated widespread nitrogen limitation, with some co-limitation by N and P as well. Despite this difference in nutrient limitation from freshwater lakes (which are usually P-limited), prairie saline lakes often followed a similar pattern in phytoplankton seasonal succession. Deviations from this pattern may be due to water chemistry, depth, or zooplankton grazing. [Session 6]

COULD RESOURCE LIMITATION CONTROLS ZOOPLANKTON DYNAMICS IN A SALINE TROPICAL LAKE?

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Three species compose the zooplankton assemblage of Lake Alchichica: one calanoid copepod (Leptodiaptomus garciai) and two rotifers (Brachionus plicatilis group and Hexarthra jenkinae). During the year, zooplankton density changes drastically (< 1 x 10E6 to > 3 x 10E6 org m-2). Copepods are the most abundant and homogeneously distributed in the water column during periods of circulation and during the onset of stratification. During stratification, copepods diminish drastically while numbers of rotifers slightly increase. However, the overall zooplankton density is lower during periods of stratification compared with periods of circulation. Seasonal changes in the zooplankton abundance are not significantly correlated with any environmental variable. Thus, bottom-up (food availability) and/or top-down (predation) controls seem to be responsible for zooplankton dynamics. Higher numbers of copepods and rotifers are associated with the most productive period (circulation) when relatively high abundance of edible phytoplankton (< 20 um) occurs. Besides its oligotrophic status, the phytoplankton is dominated by large (> 40 um) species which small zooplankters find difficult to handle and eat. Our results suggest that the zooplankton assemblage in Alchichica is resource limited during most of the year. [Poster]

BIOCHEMICAL TOOLS AND NUTRIENT ENRICHMENT ASSAYS REVEAL PHYTOPLANKTON NUTRIENT LIMITATION BY NITROGEN, PHOSPHORUS, AND IRON IN PRAIRIE SALINE LAKES

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We examined phytoplankton nutrient limitation by nitrogen (N), phosphorus (P), and iron (Fe) in prairie saline lakes with high concentrations (ranging from 10-800 mg L-1) of dissolved organic material (DOM), a large fraction of which is non-chromophoric. Due to high DOM concentrations, total nutrient concentrations in these lakes are high, but the size of the bioavailable fraction is unclear. In addition to total and dissolved nutrient measurements, we determined seston nutrient ratios, alkaline phosphatase activity (APA), and the ferredoxin index (an indicator of iron deficiency) of diatoms. Nutrient enrichment experiments were conducted on a sub-set of these lakes in the spring and summer of 2006, with the response of total algal biomass assessed across different treatments. The enrichment experiments revealed strong N limitation across all lakes, with secondary P and Fe limitation in some cases. Across the lake surveys, results from the biochemical tools (APA and ferredoxin index) were consistent with those from the enrichment experiments, whereas seston nutrient ratios and total and dissolved nutrient concentrations did not accurately reflect nutrient limitation patterns. [Session 6]

CHARACTERIZATION OF BACTERIOPHAGE ISOLATED FROM THE GREAT SALT LAKE

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Bacteria predation by bacteriophages is reported to have a significant impact on controlling bacterial populations in the Great Salt Lake (GSL). There are very few reports of bacterial predation by bacteriophage in the GSL. Bacterial strains previously isolated from the south arm of the GSL on 8% NaCl halophilic medium were used as potential prey. Water samples obtained from the south arm were centrifuged then filtered to remove bacteria and tested for bacteriophage activity by using plaque assay in soft agar. A common moderate halophile in the GSL, Vibrio costicola, identified based on morphology, Gram stain, and 16S rRNA was found to be a susceptible host to bacteriophage. Amplification of this bacteriophage isolate (NS01) in broth culture resulted in a titer of 108 pfu/mL. NS01 bacteriophage activity was destroyed by boiling but not by freezing. Scanning electron microscopy revealed icosahedral morphology. Molecular analysis of NS01 bacteriophage suggests it is a DNA bacteriophage.
[Session 1]

BACTERIA, ARCHAEA, AND DUNALIELLA TRAPPED IN FLUID INCLUSIONS IN ANCIENT HALITE, DEATH VALLEY, CALIFORNIA

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Bacteria, Archaea, and Dunaliella cells occur in primary fluid inclusions in 10,000-100,000 year old halite crystals from a 90-m long salt core drilled in Death Valley, CA. Probable prokaryote cells are miniaturized cocci (<1 µm diameter) and very rare rods (<2 µm long), which supports interpretations that the microbes are indigenous to the halite and that starvation-survival may be the normal response of some microbes to entrapment in fluid inclusions. Microorganisms are most abundant in clear bottom growth halite interpreted as crystallizing in a perennial saline lake 10,000-35,000 years ago, which suggests trapping and preservation of microorganisms in fluid inclusions is influenced by the original environment in which the halite precipitated. Microscopic observation of cells does not substantiate their viability. Surface sterilization and dissolution of 881 single halite crystals from the Death Valley core resulted in the growth of six halophilic Archaea and two halotolerant Bacteria, all from clear bottom growth halite (22,000-31,000 years old). Samples yielding positive cultures contained abundant Dunaliella and prokayotes. Glycerol in Dunaliella may provide an energy source for trapped microorganisms to survive for millennia. [Session 1]

A STUDY OF PHYSICOCHEMICAL CHARACTERIZATION OF URMIA LAKE (A COMPARATIVE APPROACH)

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Urmia Lake, located in northwest Iran, is the largest lake in Iran and the 20th largest lake in the world. In addition to seasonal fluctuations in area, it has undergone a significant decrease in size in recent years. Its area was ~5500 km2 in 1995 and subsequently decreased to 4304 km2 in 2003-04. The average salinity of the lake was 168 ppt in 1995 and increased to 275 ppt in 2003-04. According to a previous study, the lake has been salinity stratified in the spring but not significantly in autumn. Ionic structure of the lake consists of Na+, Ca2+, Mg2+, K+, Cl-, SO42-, HCO3- and Br-. Comparing the ionic concentration (w/w%) of the Great Salt Lake with Urmia Lake shows that, the concentrations of Cl-, SO42-, Mg2+, K+ in Great Salt Lake are 1.3, 2, 2 and 5.8 times more than Urmia Lake. However, Ca2+ concentration in Urmia Lake is 3.75 times more than in the Great Salt Lake. Na+ concentration is similar. [Poster]

SOLUBILITY AND SUPERSATURATION OF LITHIUM CARBONATE OF THE ZABUYE SALT LAKE BRINE

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The solubility of lithium carbonate and the supersaturation of lithium carbonate based the composition of Zabuye Salt Lake brine were measured. The solubility of lithium carbonate was studied with isothermal methods. The effect of the sodium carbonate on the solubility of lithium carbonate was also studied. The supersaturation of the lithium carbonate was studied with different heating rates. [Poster]

DEATH, DEOXYGENATION AND DIVERSITY IN A DESERT LAKE: THE STRUCTURING IMPACT OF SULFIDE IRRUPTIONS ON MICROBIAL COMMUNITIES IN THE SALTON SEA, CALIFORNIA

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One of the most significant water quality problems of the Salton Sea is high concentrations of hydrogen sulfide (H2S). High water temperatures and the development of phytoplankton blooms during the summer months lead to the development of anoxia and H2S in bottom waters. Frequent windstorms mix these H2S-rich bottom waters into surface waters, causing the mass mortality of plankton, macroinvertebrates, and fish. Although similar phenomena have been documented in freshwater and marine environments, how such events affect microbial community structure has not been investigated. Microbial community structure was determined along two transects passing through an H2S-rich plume that developed during a mixing event in 2005. Community fingerprinting (T-RFLP) was used to analyze and contrast community structure of Archaea and Bacteria. Community structure analyses revealed two distinct community "types" in both groups and were correlated with H2S concentration, and to a lesser extent oxygen concentration and temperature. Differences between community types were stronger in Archaea. Aside from the immediate effects of these mixing events on biota, shifts in microbial community structure may also lead to changes in biogeochemical cycling. [Session 1]

DRAMATIC BLOOMS OF PRYMNESIUM SP. (PRYMNESIOPHYCEAE) AND ALEXANDRIUM MARGALEFII (DINOPHYCEAE) IN THE SALTON SEA, CALIFORNIA

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In early 2006, unusual algal blooms of two species occurred in the Salton Sea, a large salt lake in southern California. In mid-January local residents reported bioluminescence in the Sea. Starting in February, large rafts of long-lasting foam, also bioluminescent, were observed as well. Microscopy investigations on water and sediment samples collected in March showed the marine dinoflagellate, Alexandrium margalefii, and the prymnesiophyte, Prymnesium sp., both previously unreported in the Salton Sea, to be abundant. Bioluminescence and foam production continued through March. Other dinoflagellate species were rare or not detected during these blooms. Despite the fact that many Alexandrium species are known paralytic shellfish poison (PSP) producers, preliminary saxitoxin tests on this population of A. margalefii were negative. Previous reports on A. margalefii do not mention bioluminescence. It appears that the foam was caused by the Prymnesium sp. bloom, probably due to lysis of other algal cells and/or mucilage production, and its glow was due to entrained A. margalefii. This is the first report of A. margalefii in U.S. waters and the first report of it in a lake. [Poster]

A STUDY OF THE SALINE LAKES OF THE ESPERANCE HINTERLAND, WESTERN AUSTRALIA, WITH SPECIAL REFERENCE TO THE ROLE OF ACIDITY AND EPISODICITY

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Most saline lakes are alkaline, but acid groundwaters inland of Esperance cause some to have pHs as low as 3. Their fauna is severely restricted to an endemic brine shrimp (Parartemia n. sp), a copepod Boeckella trilobata, and a couple species of ostracods, including Australocypris bennetti. Nearby alkaline salt lakes show an attenuating fauna with increasing salinity with dominance by various crustaceans particularly Parartemia spp, various ostracods, copepods, Daphnia (Daphnioposis) truncata, Haloniscus searlei and snails including Coxiella glauerti, as is typical in salinas in southern Australia. Should both types of lakes fill with episodic rain, their salinity is vastly reduced and pH approaches neutral. Such lakes are colonised by insects and by large branchipods. Many of the later are new to science and occur only in these brief hyposaline stages. Such a unique assemblage is in danger of extinction due to hypersaline mining waste waters being dumped in saline lakes and to secondary salinisation. [Session 9]

RESIDENTS' RELATIONSHIPS WITH A SALINE LAKE: THE EFFECTS OF PHYSICAL TRAITS

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Using Great Salt Lake, Utah, as a case study, this research examines how the physical traits of a saline lake affect how local residents think and feel about the lake. Social science research on sense of place, place attachment, and caring for a place have found that these dynamics can be positively associated with support for resource management, environmental concern, sensitivity to environmental impacts, and more of a commitment to the place. These studies have considered the relationships between people and fresh water lakes, among other settings. However the physical traits of terminal lakes, including general landscape differences, differences in flora and fauna, in recreation opportunities, odor, and the variable size of shallow, terminal lakes, lead to substantial differences in the dynamics of relationships people have with saline lakes. Using both qualitative and quantitative data, this research examines relationship dynamics between residents and a saline lake. [Session 12]

PRODUCTION OF MAGNESIUM FROM THE GREAT SALT LAKE

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Magnesium metal has been commercially produced from the waters of the Great Salt Lake for the past 36 years. Worldwide use of magnesium has markedly increased over the last twenty years due to its unique properties of low density and high strength. The Great Salt Lake is a valuable resource for the recovery of magnesium minerals due to its chemical composition, natural geography/climate and proximity to transportation and markets. US Magnesium LLC and its predecessors have overcome various technical challenges as well as political hurdles, climatic calamities and market uncertainties. This discussion will describe the extensive use of solar evaporation ponds to produce suitable raw materials for magnesium manufacture as well as significant mineral by products. It will also include a basic technical description of the magnesium metal manufacturing process, an explanation of the operating history of the Rowley Utah plant, and briefly touch on the current commercial uses of magnesium metal. [Session 7]

LIMNOLOGY AND AQUATIC FOOD WEB STRUCTURE OF A LARGE TERMINAL LAKE

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Walker Lake is a large, terminal, saline lake in the Western Great Basin of the United States. Diversions have greatly reduced river inflow which has lead to a decrease in volume by 75% since the 1880ís. As a result there has been a concomitant increase in salinity levels and alteration to biotic community structure. This study provides a contemporary snapshot of the water quality, phytoplankton- zooplankton biomass, and the lakeís food web structure. Water quality and chlorophyll a and zooplankton were sampled monthly (March to October 2007) from six locations at discrete depths. Nutrient concentrations were highly variable (ammonium levels- 0 to 30 ppb, nitrate- 0-12 ppb, total and dissolved phosphorus-500 ñ 1000 ppb, and soluble reactive phosphorus- 400 ñ 600 ppb). The food web structure determined from stable isotope measurements (carbon and nitrogen) and stomach contents suggests benthic resources contributed greatly to fisheries energetics. [Session 14]

CAROTENOIDS AND PHOTOPROTECTION IN GREAT SALT LAKE HALOPHILES

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Carotenoids have been correlated with photoprotection in many studies on halophilic archaea, but data has not revealed the mechanism by which they work. The literature reveals environmental factors which affect the production of carotenoid pigments in various halophile species. Several of the factors pertain to the conditions in which the halophiles are grown. These include light, salinity, aeration, and nutrition. Our study centered on varying the light conditions from total darkness to constant light exposure. The Great Salt Lake strain, "Halorubrum salsolis," grown in either of these conditions exhibited significant pigmentation differences. We have confirmed this difference in carotenoid composition within a single species using spectrophotometry methods, combined with cell counting, and HPLC methodology. We also tested each of the cultures for UV resistance by examining DNA damage and repair. Measurements of DNA damage showed a connection between light exposure, carotenoid production and the production of photodamage in these cells. These experiments underscore a relationship between carotenoid levels and UV resistance. [Poster]

ARTEMIA OF THE ARAL SEA, UZBEKISTAN: FIELD SURVEY OF AN EMERGING POPULATION AND PERSPECTIVES FOR COMMERCIAL EXPLOITATION

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This paper reports on a 2005-í07 sampling programme on the Uzbek part of the Aral Sea, within the framework of a NATO Science for Peace project with the following objectives: a) characterize the Aral Sea Artemia population in terms of life history, population dynamics (and ecological conditons affecting them), cyst quality characteristics and potential for aquaculture; and b) issue recommendations on optimal sustainable resource management. As a consequence of progressive evaporation, the original Aral Sea has shrunk to a complex of smaller, isolated or more or less interconnected water bodies. The main remaining water bodies, the East and West Aral, each face basic problems for a commercial Artemia exploitation, such as difficult accessibility and low productivity. As there are no concrete short or medium-term indications that these basic impediments for Artemia exploitation are likely to alter in a positive sense (cfr also the uncertainties about a comprehensive local, national and international water policy for the tributary rivers) a commercially viable Artemia industry at West or East Aral thus seems unlikely in the foreseeable future. [Session 14]

INORGANIC CONTAMINANT CONCENTRATIONS AND BODY CONDITION IN WINTERING WATERFOWL FROM GREAT SALT LAKE, UTAH

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The Great Salt Lake (GSL) is an important region for millions of migratory waterbirds. However, elevated concentrations of some trace elements (e.g., Hg, Se) have been detected within GSL and avian ecotoxicology data are needed. We evaluated trace element concentrations in livers of two waterfowl species (common goldeneye [COGO], northern shoveler [NSHO]) during winter on GSL. We found concentrations of Hg increased nearly threefold in COGO and doubled in NSHO during winter. Hg concentrations were among or exceeded the highest levels reported for these species. Se concentrations were above background levels in 73% and 57% of COGO and NSHO samples, respectively. We detected a weak negative relationship (r2 = 0.11) between spleen mass and Hg concentrations in female COGO and pancreas mass was negatively related to both Se (r2 = 0.05) and Hg (r2 = 0.06) concentrations in male COGO. However, we detected weak positive relationships between Se and lipid levels in COGO (r2 = 0.04) and NSHO (r2 = 0.11). Measures of waterfowl body condition (total lipid mass, total protein content, spleen mass and pancreas mass) do not appear to be greatly influenced by the range of contaminant concentrations we observed.
[Session 11]

U.S. FISH AND WILDLIFE SERVICE SYNOPTIC EVALUATION OF CONTAMINANTS EXPOSURE IN THE WETLANDS AND OPEN WATERS OF THE GREAT SALT LAKE, 1996-2000

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Between 1996 and 2000, the U.S. Fish and Wildlife Service conducted a screening-level survey of contaminants in the major wetlands around the Great Salt Lake and the open waters of Gilbert Bay. Over 600 samples of sediment, macroinvertebrates, fish, and bird eggs were analyzed for metals and organic compounds including polychlorinated biphenyls (PCBs) and chlorinated pesticides, as well as biomarkers of contaminants exposure in fish. Initial findings (1996 and 1997) indicated that while Great Salt Lake's wetlands contain a variety of contaminants, overall exposure of wildlife to most metals and organic compounds was relatively low. Additional studies were conducted at several areas to evaluate potential avian exposure to mercury, selenium, polynuclear aromatic hydrocarbons (PAHs) and petroleum hydrocarbons. Data collected during this study have been important in subsequent issues on the Great Salt Lake, including the development of a water quality standard for selenium and efforts to characterize the movement of mercury through the food chain of the lake, and will continue to be useful in evaluating sources and effects of contaminants in other areas of the lake and its wetlands. [Session 11]

CONSTRUCTION AND OPERATIONAL EXPERIENCE OF ZABUYE SALT LAKE SOLAR POND IN TIBET, CHINA

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The temperature distribution and the solution density distribution in solar ponds was investigated. The largest gradient of temperature and solution density was found near the surface of the ponds. The higher temperature was located in the bottom and middle of the pond. The method to establish the salt gradient layer of Zabuye Solar Pond during the different seasons in a year was also tested. [Poster]

SURVEYING THE METABOLIC DIVERSITY OF THE GREAT SALT LAKE

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The hypersalinity of the Great Salt Lake (GSL) excludes all but the most resilient of life. Aside from brine flies, shrimp and visiting water foul, the GSL is restricted to microorganisms; ecosystem processes are driven by microbes. Despite this, the metabolic diversity and capacity of microorganisms remains unknown. We combined metabolite profiling by mass spectrometry (MS) with functional gene array data (GeoChip) to examine the metabolic potential of the GSL. Of the 500 metabolites detected, 81 were common to all three locations; 69 were unique to the North Arm, 85 to the South Arm, and 116 to Farmington Bay. Identified genes corresponded to carbon fixation (e.g. Rubisco, acetyl-CoA carboxylase), sulfur metabolism (e.g. sulfite reductase, cystathionine beta-lyase), nitrogen cycling (e.g. nitrogenase, ammonia monooxygenase, hydroxylamine oxidoreductase, urease). This was consistent with metabolites in these categories – carbon fixation (e.g. sedoheptulose, biotin, pentose), sulfur metabolism (e.g. formyldihydrofolate, serine, phosphohydroxypyruvate, sulfate, succinyl-glutathione), and nitrogen cycling (e.g. nitrite, hydroxylamine). This combinatorial approach provides direct linkages of microbial genes to ecosystem processes and functions, especially useful in virtually unexplored ecosystems such as the GSL. [Session 1]

MAPPING WETLANDS IN THE GREAT SALT LAKE ECOSYSTEM USING AIRBORNE MULTISPECTRAL DIGITAL IMAGERY

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Wetlands play an important eco-hydrological role. Their size, location and function are affected by numerous factors such as variations in water availability, water quality, geomorphic characteristics and anthropogenic factors such as runoff from irrigation systems, or discharge of urban effluents. Typically, wetland vegetation occurs in patches of variable size and plant species composition, requiring high-resolution imagery to accurately identify distribution and extent of the different wetland habitat types when mapping these complex systems. Airborne multispectral digital imaging offers several advantages, including cost-effectiveness and ability to resolve wetland features ranging in size from a few meters to hundreds of hectares. This paper describes the mapping of wetland habitats in Farmington Bay within the Great Salt Lake Ecosystem using high spatial resolution multispectral imagery. Image classification was based on super¬vised signature extraction and the Maximum Likelihood scheme supported by comprehensive ground truth data and field verification. The paper will describe the methodology used in the mapping, including an error analysis to determine the final classification accuracy of the product. [Session 3]

FLUID CHEMISTRY AND MINERALOGY OF SURFICIAL SEDIMENTS IN THE NEWFOUNDLAND BASIN, TOOELE AND BOX ELDER COUNTIES, UTAH

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A two-year field study of the Newfoundland Basin's shallow-brine aquifer and associated playa and lacustrine sediments was concentrated in the area flooded by Great Salt Lake brine during the West Desert pumping project (April 1987 - June 1989). Chemical and mineralogical characterization was performed on brine and selected core samples collected from the shallow-brine aquifer and sediments intercepted by 24 boreholes and 8 sets of nested monitoring wells. Effects of the pumping project included altering the Newfoundland Basin shallow-brine aquifer by mixing two chemically different brines, and depositing halite salt crust where none was previously reported. Within the first 1.5 meters of basin-center sediments, K, Mg, and SO4 pore-fluid concentrations were as much as 0.9, 1.3, and 4.5%, respectively, essentially matching Great Salt Lake brine values. Below 1.5 meters, pore-fluid concentrations decreased to < 0.5% for K and Mg, and <2% for SO4, generally matching evaporated remnants from Lake Bonneville waters. Core mineralogy showed that gypsum (below halite) increased up to 75% toward the basin center at depths greater than 1 meter. Conversely, aragonite generally increased with depth toward the basin periphery. [Session 13]

WINTER POPULATIONS OF BALD EAGLES (HALIAEETUS LEUCOCEPHALUS) ON GREAT SALT LAKE

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Large numbers of Bald Eagles (Haliaeetus leucocephalus) over-winter on Great Salt Lake in northern Utah. Eagles occupy multiple communal roosts associated with wetlands on the east shore of GSL. Two of these roosts, Willard Canyon and Ogden Bay, are among the largest documented in the lower 48 states. During the winters of 1997-98 and 1998-99 we documented the geographic location, habitat, and occupation of these sites. Willard Canyon had a maximum of 227 eagles in March of 1998 and 363 in January of 1998. Ogden Bay had a maximum of 153 eagles February 1998 and 264 in March 1999. The Willard Bay roost is associated with the Bear River delta while eagles at the Ogden Bay roost utilize the Weber River delta. A third roost up Centerville Canyon is associated with the Jordan River delta. [Session 10]

THE EFFECTS OF INCREASING TOTAL DISSOLVED SOLIDS ON THE WALKER LAKE, NEVADA, FISHERY

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Walker Lake, a desert terminal lake, is remnant of Pleistocene Lake Lahontan. Upstream agricultural diversions along the Walker River (primarily in Nevada) have resulted in an approximately 150 foot drop in lake elevation since the mid 1800ís. The problem is the increasing total dissolved solids (TDS) which reduces survivability of the only remaining fish species in the lake, the Lahontan cutthroat trout (LCT) (Oncorhynchus clarki henshawi), and Lahontan tui chub (Gilia bilcolor pectinifer and G. b. obesa). High TDS, currently around 16,000 mg/L, results in poor success in acclimation of annually stocked LCT. LCT are stocked in the river with flows sometimes lasting for only a few days. As LCT migrate into the lake, they possibly acclimate in the freshwater/saline water mixing zone, increasing survival. Examinations of stocked LCT surviovorship, recruitment of tui chub, zooplankton composition and abundance, as well as monitoring water quality are currently part of an extensive study on Walker Lake. Adaptive management strategies are currently being developed to increase LCT stocking survival and tui chub recruitment, while others agencies work on increasing water to the lake. [Session14]

EUTROPHICATION, NUTRIENT FLUXES, AND CONNECTIVITY BETWEEN BAYS OF THE GREAT SALT LAKE, UTAH (USA)

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Natural geography and causeways have divided the Great Salt Lake into four bays that are interconnected by breaches. Farmington Bay, in the southeast, receives excessive wastewater discharges from metropolitan Salt Lake City, and is hypereutrophic with massive blooms of the toxic cyanobacteria Nodularia when salinities are less than 5%. Brine shrimp production in this bay is minimal because of poor water quality and/or invertebrate predation. Loading of the limiting nutrient (N) to Gilbert Bay was dominated by Bear River inflows during spring runoff, but during summer, loading from Farmington Bay predominated. MODIS satellite imagery documented plumes of phytoplankton-rich water flowing out of Farmington Bay and overflowing into Gilbert Bay. Isotopic analyses of 13-C and 15-N at 34 stations indicated, however, that the high algal production in Farmington Bay did not contribute substantially to the diets of brine shrimp in Gilbert Bay, at least during the May, June and November synoptic analyses. The management of nutrient loading and other pollutants in the Great Salt Lake will need to take into account the close coupling of the bays. [Session 12]

THE RANKING OF WATER BODIES OF SOUTH OF UKRAINE BY HYDROCHEMICAL AND BIOLOGICAL CHARACTERISTICS

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Black Sea lowland includes the hundreds of saline water bodies (mineralization - 1 - 300 g/l) with unique features of hydrological and hydrobiological modes. Primary production varied in the range of 2 orders of values. On more than 50 water bodies was shown the possibility of their association in the groups of different size and salinity. The special attention is spared to objects by an area less than 1 km2. The morphological and biogeochemical variety is one of the main factors that form variety of water biocenoses and caused the biodiversity index in them.
Primary production and destruction level, nutrients concentration, biomass abundance, biodiversity indexes are the total descriptions the investigated water bodies. Rate levels of production, destruction and sedimentation can be used for the estimation of water bodies role as carbon buries. Correlation of supplies and concentrations of nitrogen and phosphorus specifies the ways of the rational use in economic aims. The special attention is deserved by hypersaline nitrogen-deficit water bodies which simultaneously are the buries of carbon and sources of such important products as β-carotin and Artemia salina. [Poster]

PHASE DIAGRAM FOR THE TERNARY SYSTEM CONTAINING LITHIUM, SODIUM AND SULFATE AT 273^{o} K

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Zabuye, a salt lake located on the Tibet Plateau, is one of the carbonate alkaline lakes noted for its high concentrations of sodium, potassium, lithium and borate. It is proven that in the process of evaporation, the equilibria relationships among salts in brines are always metastable. Thus the investigations of the metastable equilibria are very important for exploiting salts from saline brines. In this paper, the solubilities and densities of equilibrium solution were studied in the ternary system Li+, Na+ // SO4-2 •H2O at 273o K by an isothermal evaporation method. Phase diagrams and density-composition diagrams of the ternary system were plotted. The isothermal diagram consists of three univariant curves and three crystallization fields corresponding to the single salts Li2SO4•H2O, Na2SO4•10H2O and also to complex salts 3Na2SO4.Li2SO4•12H2O, respectively. One invariant point is saturated with salts Na2SO4•10H2O and 3Na2SO4.Li2SO4.12H2O, and the mass fraction of its equilibrium solution is w (Li2SO4) 23.22 % and w (Na2SO4) 6.91%. The other invariant point is saturated with salts Li2SO4•H2O and 3Na2SO4.Li2SO4.12H2O, the mass fraction of equilibrium solution is w (Li2SO4) 24.62% and w (Na2SO4) 5.56%. [Session 7]

PALEOENVIRONMENTAL RECORDS OF ZABUYE SALT LAKE ON THE TIBETAN PLATEAU, CHINA, SINCE THE LATE PLEISTOCENE

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Good age data have been obtained according to a high-resolution study of lake core samples from 7 holes in Zabuye Salt Lake, Tibet, and continuous paleoenvironmental records of the salt lake from ~800 a to 125 ka BP have been examined. On the basis of an integrated analysis of d18O, U37K and C/N of authigenic calcium-magnesium carbonate, as well as minerals, sporopollen and microfossils of the lake core and by correlations of oxygen isotope changes between this lake core and the Greenland and Guliya ice cores and Atlantic float ice, the following events have been recognized: the last interglacial stage of glacial period 5 to postglacial stage of glacial period 1, 6 Heinrich (H6–H1) events, the Younger Dryas and 8.2 ka global cold events (4.2/4.4–3.1, 2.8–2.6 and 2.0–1.25 ka). The sediments of Zabuye Lake are valuable paleoenvironmental records. [Session 13]

THE IMPORTANT ROLE OF ECTOINE IN THE FAST GROWTH OF MARINE BACTERIUM SALINIVIBRIO COSTICOLA SUBSP. YANIAE

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A moderate halophilic bacterium, Salinivibrio costicola subsp. yaniae DL6T (NCCB 100212), attracted our attention for the fast rate of growth, the doubling time of which was 10-11 min. NMR analyses showed that glycine betaine, ectoine, and glutamate were the predominately compatible solutes in strain DL6 when grown in the high osmolarity. For these solutes, we clarified that glycine betaine was taken up from the medium or synthesized through choline and that ectoine as well as glutamate were synthesized de novo. To detect the effects of compatible solutes on growth of strain DL6, we constructed mutant strain possessing the delayed growth rate severely and NMR analysis showed ectoine synthesis was absent. But when ectoine was supplemented, the growth rate of mutant strain significantly improved. In addition, the supplement of glycine betaine was able to improve the tolerance level of strain DL6 to salinity but cannot shorten the doubling time. Since fast growth rates have been mainly found in marine bacteria, we suppose that the ectoine or other compatible solutes should be one reason to shorten the generation time for marine bacteria. [Poster]

PHOSPHATE AND PHOSPHONATE USE BY MICROORGANISMS ISOLATED FROM HYPERSALINE ENVIRONMENTS OF THE GREAT SALT LAKE, UTAH

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The Great Salt Lake contains high levels of phosphate (P), however most is precipitated with minerals and not bioavailable for microorganisms. Using a non-specific saline medium, organisms were isolated from the south (8% saline) and the north arms (22% saline) of the lake. North arm isolates were related to the halophilic bacterial genera Salicola, Halomonas, or Marinobacter and the archaeal genera Natronococcus and Haloarcula, while south arm isolates were related to Halomonas and Salinivibrio. The ability of isolates to utilize phosphate esters, phosphonates, or inorganic P as the sole P source was determined using 96 well plates containing a P-free minimal medium amended with 1 mM of each P source. Most isolates demonstrated a preference for certain P sources. Several grew quickly on 1-aminoethylphosphonic acid indicating their ability to cleave the phosphonate's C-P bond. Some isolates grew with no added P, indicating they may possess a mechanism for scavenging very low levels of available P. A dose-response assay with the herbicide, glyphosate, inhibited growth when it was the only phosphate source, but not when isolates were also given KH2PO4. [Poster]

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