What About This

Great Salt Lake?

III. Biotic Features

THE GREAT SALT LAKE ECOSYSTEM consists of approximately 15,000 square miles of water environment, with numerous islands and remote shorelines offering wildlife sanctuary from predators and human disturbance. A gradation of saline environments and periodic fresh water flushing have over thousands of years conceived a dynamic yet stable system. The ecosystem responds to such variables as annual runoff, salinity, temperatures, water circulation, nutrient balances, cloud cover, and stream effluent in concert with biotic factors such as disease, predation and birth success. Great Salt Lake is tied to its neighboring Wasatch Mountains by ribbons of riparian (water-based) habitats, critical for neo-tropical migrant songbirds, raptors, and riverine mammals. Many of these riparian subsystems have been compromised by human activity, causing those remaining to become magnified in importance. Because Great Salt Lake is a terminal lake, minerals, effluent and chemical pollutants are collected and concentrated in the system.

WETLANDS are among the most biologically productive systems in the world. Those of the Great Salt Lake Ecosystem occupy approximately 400,000 acres, or nearly 3/4 of all wetlands in Utah, which in total comprise just over 1% of the state. Periodic flooding, while inconvenient to those who have chosen to develop close to the lake, provides the benefits of nutrient dispersal and plant revitalization. Wetland services include seasonal flood water storage and ground water recharge, water purification, wildlife habitat, and recreational opportunities. The marshes, playas, and upland vegetation zone serve as critical buffers to outside disturbances. About half (200,000 acres) of Great Salt Lake wetlands are currently protected to some degree.

PROTECTED WETLANDS on Great Salt Lake are the 74,000 acre Bear River Migratory Bird Refuge managed by the US Fish & Wildlife Service, and several units managed by the Utah Division of Wildlife Resources, including the following: Farmington Bay Waterfowl Management Area (WMA), Harold Crane (Willard Bay) WMA, Locomotive Springs, Ogden Bay WMA, Public Shooting Grounds, Salt Creek, and Timpie Springs WMA. Wetlands protected by private organizations include the 1400 acre Gillmor Sanctuary (Audubon), the 3400 acre Great Salt Lake Shorelands Preserve (Nature Conservancy), and those of various private duck clubs.

LIFE IN THE GREAT SALT LAKE SYSTEM includes species or subspecies of 8 amphibians, 19 reptiles, 64 mammals, more than 250 birds, and hundreds of plants, invertebrates and microorganisms. In addition to 23 species of fish found in fresher water peripheries, the lake's aquatic lifeforms include dozens of species of algae, bacteria and protozoa, brine shrimp, and the egg-larva-pupa stages of two Ephydra fly species. These organisms are particularly critical to system-wide food webs.

PAST LIFE OF GREAT SALT LAKE, based on fossil evidence, included two types of musk oxen, the mammoth, a horse, a camel, mountain sheep, two types of bison, and a giant bear. All are now extinct. Archeological evidence suggests that the wetlands formed around the east, north, and south shores of Great Salt Lake provided significant resources for both Native American and European visitors and occupants during the past 12,000 years.

PLANTS of the Great Salt Lake system include flora typical of western riparian habitats and Great Basin environments, plus a number of halophytic (salt-adaptive) specialists. Plants found in the immediate lake vicinity withstand stresses such as alternate flood and drought, variations in water and soil salinity, extreme heat and evaporation during summer, and the extreme cold of winter. Some notable halophytes possessing varying levels of salt tolerance are Alkali Dropseed, Four-Winged Saltbush, Greasewood, Inkweed, Iodine Bush, Pickleweed, Salt Grass, and Shadscale. To cope with high salt concentrations, many of these plants control salt by excretion through leaf glands; by leaf saturation, disposal and regrowth; or by internal regulation and storage.

BRINE FLIES exist as two species at Great Salt Lake, neither of which bite or are inclined to land on people. Beginning in spring, female flies each lay approximately 75 eggs on the lake's surface. These eggs hatch to grow into half-inch tubelike larvae, which feed on algae and eventually attach themselves to the lake bottom. The larvae soon contract within their pupal shells, each creating an air bubble that floats it back to the surface where the adult fly emerges. During summer the lake shores testify to brine fly productivity with masses of empty larval cases washed upon the shore. An estimated 5,000 billion brine flies hatch at Great Salt Lake each year. At their summer peak, there can be 110 billion flies at any moment along 335 miles of lake shoreline. Contrasting with this abundance, the brine fly life span is just 3–4 days. During their brief lives they eat great quantities of algae, bacteria, and organic waste from both brine shrimp and their own life processes. The water cleansing provided by brine flies has been said to be more efficient than a $75 million sewage treatment plant operating at an annual cost of $3 million. Brine flies remove about 120,000 tons of organic matter from the lake each year. Without the flies, it is believed algae would essentially take over the lake and Great Salt Lake as we know it would cease to exist. A noteworthy symbiotic relationship

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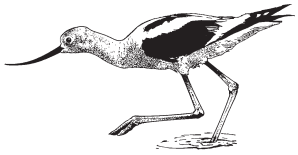
between brine flies and brine shrimp relates to water clarity. After shrimp have grazed much of the lake's algae during summer, mid-lake waters become very clear. This allows more light to reach down to the lake bottom, which then stimulates the growth of blue-green algae—the food of the brine fly larvae.

BRINE SHRIMP, *Artemia franciscana,* fill a huge niche in the lake's food webs. Overwintering eggs (cysts) begin hatching with the spring "bloom" of green algae, the brine shrimps' favored food. The newly-hatched females quickly mature to begin giving birth to live young, called "nauplii." With ideal conditions each female lives three months and continues to produce several generations of nauplii. Nauplii grow to the adult size of approximately 10mm (.4") in two to four weeks. Salinity levels of 12% to 19% seem to be ideal for Great Salt Lake shrimp. Brine shrimp consumption of algae is largely responsible for the crystal clear water observed in central portions of the lake. By August or September, the females switch from bearing live young to again laying the hard-shelled eggs. The tiny eggs measure approximately 200 micrometers (2/10 millimeter), yet are so highly adapted to wait out stressful conditions that they may remain dormant but viable for many decades. With adequate food and temperatures, each female lays between 10 and 25 eggs. Nearly all brine shrimp perish by late fall, so the fate of the entire shrimp population rests on the overwintering eggs. Each spring, Great Salt Lake experiences another "instant shrimp population." What seems to limit brine shrimp are available foods plus water temperature and salinity. Reduced salinity also increases impacts from the less salt-tolerant corixid, an invertebrate predator of brine shrimp. We currently possess very limited knowledge about other factors affecting brine shrimp, such as lake chemistry or pollution. It is also unknown how many eggs can be harvested from the lake without impairing shrimp population dynamics.

THE BRINE SHRIMP INDUSTRY began in the 1950s when adult shrimp were harvested for aquarium food. Since the 1970s, cyst (brine shrimp egg) harvesting has dominated. The cysts are collected, dried, and canned for sale as food to shrimp—or *prawn*— farms overseas. Most of the prawns consumed by people in the US come from those overseas farms, and over 90% of the world's brine shrimp eggs used to produce feed on these farms come from Great Salt Lake. Between 1980 and 1994 global prawn farm production rose from 108 million to 1.5 billion pounds annually. Today over 50,000 prawn farms cover 3,800 square miles worldwide, often resulting in losses to wetlands, tidal flats and mangrove forests.

10x Actual Size

BRINE SHRIMP CYST (EGG) HARVESTING usually occurs October through January. 79 cyst-harvest permits are held by 32 companies on the lake. Permits cost $10,000 each per year, plus a 3.5% state royalty tax. An average 10 million pounds (wet weight) of cysts are harvested annually. Dry, marketable cysts comprise approximately one-third of wet harvest weight. Utah State University estimates that in the 1994-95 season 40% of the lake's approximately 1.875 x 10^{15} cysts were harvested at a rate as high as 300,000 lbs./day. In 1995-96, and again in '96-97, totals of 14.7 million pounds of cysts were removed from Great Salt Lake. In 1997, -98 and -99 the lake's adult shrimp population fell sharply, resulting in many fewer eggs and harvest totals reduced to one-third that of previous high-yield years. Harvests in 2000, -01 and -02 then rebounded with startling all-time record yields of 19.9, 18.3 and 25.7 million lbs., respectively. Causes for these fluctuating numbers are uncertain, but seem to be related to temperature and salinity, and their effects on the green algae shrimp eat. There is an ongoing study of brine shrimp ecology, funded in large part by fees paid by the harvesters. One of the study's goals is to determine what levels of harvest are sustainable for both human interests and for satisfying the lake's ecological needs, such as for that of migratory birds.



BIRD LIFE at Great Salt Lake is of global importance, earning the designation of "Western Hemisphere Shorebird Reserve." The location of Great Salt Lake and its 15,000 square miles of water environment, its remote islands and shoreline, and 400,000 acres of wetlands translates into what might best be described as a "bird magnet." Birds of regional, national, and international significance depend on Great Salt Lake for resident feeding and sanctuary, breeding, or for migratory stopover. There are 2-1/2 times more birds at Great Salt Lake through the year than there are people in the entire state of Utah! 5 *million* birds, 250 *species*, rely on the lake. The ecology of bird life at Great Salt Lake is one of the most extraordinary examples of the rich web of relationships here between land and water, food and survival. (See the Friends of Great Salt Lake companion document in this series, *What About This Great Salt Lake?: Bird Life* for more specific information.)

MAMMALS in the Great Salt Lake Ecosystem include the pronghorn antelope, badger, bison, black-tailed jackrabbit, cottontail rabbit, coyote, deer mouse, kangaroo rat, mink, mule deer, muskrat, porcupine, red fox, striped skunk, voles, and at least 49 other species.

THE LAKE'S SMELL is one of its lesser but more notorious features. The odor is not from the lake itself but from shoreline and underwater decomposition of organic debris. Because we have isolated it from the main body of the lake, Farmington Bay is a major culprit, where odors originate from bacteria fed by human-caused discharge from agriculture and sewage treatment plants.

To learn more about Great Salt Lake, and for a listing of publications from which much of this information was derived, see our What About This Great Salt Lake?: Resource List.