COMMENTS OF GREAT SALT LAKE BRINE SHRIMP COOPERATIVE, INC.

ON DRAFT GREAT SALT LAKE WATER QUALITY STRATEGY

Submitted by Thomas Bosteels

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A. It must be clearly stated that Gilbert Bay is the focus of investigations to set water quality criteria of the hypersaline category. If Gunnison Bay and the deep brine layer of Gilbert Bay are included in the investigation, a separate classification must be formulated for each.

In " CORE COMPONENT 1 : PROPOSED APPROACH FOR DEVELOPING NUMERIC CRITERIA FOR GREAT SALT LAKE" ("Core Component 1"), on pages 11 through 13, it is proposed to use salinity classes with their own set of numeric criteria as an approach to help identify unique criteria for specific biotopes. Pages 11 through 13 explain the origin of the deep brine layer and mention the differences between Gilbert Bay and Gunnison Bay. Since, only three (3) salinity classes would be adopted, i.e. fresh, saline and hypersaline, Gunnison Bay and the deep brine layer of Gilbert Bay would both be considered in the hypersaline category similar to Gilbert Bay. Lumping together these distinctly different environments, would result in setting overly-protective and artificially-low nutrient limits for Gilbert Bay which, in turn, would result in very costly and severe ecological consequences. Therefore, Gunnison Bay and the deep brine layer of Gilbert Bay must be excluded from the hypersaline category or each given its own specific category. More specifics related to the risk for overly protective measures are described below.

1. **The deep brine layer** (DBL) with its anoxic reducing environment and potentially higher levels of sequestered nutrients and/or contaminants is a unique feature of Gilbert Bay. However, the DBL represents only a fraction of the volume of Gilbert Bay. Under this classification, the DBL would be considered hypersaline as part of Gilbert Bay. If measurements of the DBL are used to assess the upper mixed layers of Gilbert Bay, this will result in a misinterpretation of the nutrient load of Gilbert Bay, with the adverse consequence of severely limiting the influx of nutrients and, consequently, threatening the health of the brine shrimp population in Gilbert Bay. This, in turn, could have far-reaching local, hemispheric and global ecological and economic consequences.
2. **Gunnison Bay** is characterized by a much higher salinity (typically saturated) and has a much lower capacity to sustain biological life and consequently to absorb and cycle nutrients. Using investigations of Gunnison Bay to set nutrient criteria for the hypersaline category will drastically limit the nutrient criteria for Gilbert Bay and, consequently, threaten the health of the Brine shrimp population. This, in turn, will have far-reaching local, hemispheric and global ecological and economic consequences.

B. The document must clearly emphasize the interrelated aspects of the biotopes created by the salinity classes.

In "GREAT SALT LAKE WATER QUALITY STRATEGY" ("Strategy"), on page 4, line 81 through 89, the strategy recognizes Great Salt Lake's unique characteristics that require an approach to water quality specific to the lake; which is a valid and worthy statement. Additionally, in Core Component 1 (pages 11 through 13) it is proposed to use salinity classes as an approach to help in identifying unique criteria for specific biotopes. On Page13, lines 352 through 381 of Core Component 1, and on page 5 of the Strategy, lines 124 and 125, it emphasizes the differences between the bays but only summarily mentions the interconnectivity. It must be clearly emphasized that important linkages exist between the different biotopes and that the health of one biotope may be significantly affected by regulations applied to another.

For example, the high nutrient loads in Farmington Bay are an important source of nutrients to the biota of Gilbert Bay. These nutrients are very quickly absorbed in Gilbert Bay resulting in healthy algae production and high dissolved oxygen which, in turn, results in a healthy brine shrimp population in Gilbert Bay. Severely limiting nutrients in Farmington Bay will adversely affect the biota of Gilbert Bay and threaten the brine shrimp population which, in turn, will result in severe local, hemispheric and global ecological and economic consequences.

C. The document must continue to specify that Core Components 1 and 2 are addressing toxic contaminants and not addressing nutrient criteria. Additionally, it should be clearly mentioned that many aspects of nutrient contribution and nutrient cycling on Great Salt Lake are still unknown.

Core Component 1, page 6, lines 149 through 154, clearly mentions that efforts to derive numeric nutrient criteria are not detailed in the present version of the Great Salt Lake Water Quality Strategy. It is important that this comment is retained. The reason given for omitting numeric nutrient criteria in the present version is the difference in approach to derive numeric criteria for nutrients as compared to toxic pollutants. Additionally, it must be explained in Core Component 1 that nutrient aspects of Great Salt Lake water quality are only partially understood and may need a totally separate approach, possibly even a narrative approach rather than the numeric approach for certain salinity classes.

The Strategy (page 4, line 81 through 89) recognizes Great Salt Lake's unique characteristics that require an approach to water quality specific to the lake. It should be further emphasized that many aspects of nutrient contribution, nutrient cycling and nutrient consumption in Great Salt Lake and especially in Gilbert Bay are still unknown.

Following are some nutrient-related aspects that characterize the hypersaline classification as truly unique and that elaborate on some of the gaps in nutrient information available with regard to the hypersaline classification. It is widely believed that Gilbert Bay is nitrogen limited. However there is no information available as to the level of nitrogen that can actually be absorbed by the biota of Gilbert Bay. Although Gilbert Bay is characterized by frequent algal blooms, which is one of the characteristics typically associated with eutrophication, these blooms do not ultimately result in oxygen deficiency as is more typical of eutrophic aquatic environments. The *Artemia* population readily grazes the abundant algae, the result of which is herbivore control of the algal population. During times of algal blooms the dissolved oxygen levels in Gilbert Bay are characteristically well above atmospheric saturation levels indicating that the processes underlying eutrophication are not developing. The brine shrimp population then serves as a food source for a truly phenomenal number and diversity of migratory birds. This boom and bust cycle between algae and brine shrimp, that is characteristic of Gilbert Bay predator-prey population dynamics, results in a great capacity for Gilbert Bay to assimilate available nitrogen and sets Great Salt Lake apart from many other aquatic environments.

Although there is some recent information available with regard to nutrient contribution from the major drainages into Great Salt Lake, there are still many gaps in the data. It is widely recognized that cyanophytes are typically a significant factor in binding atmospheric nitrogen, it is also known that this capacity is significantly hampered at elevated salinities. There is a paucity of data available with regard to atmospheric nitrogen contribution to Gilbert Bay. No data are currently available as to the contribution from, or the sequestering of, nutrients in the deep brine layer of Gilbert Bay. In fact there is only limited hydrological information available with regard to the mixing zones between the deep brine layer and the upper mixed layers. Although it is known that the deep brine layer is highly variable and changes with changing lake elevations, little is known with regard to the hydrodynamic exchange of brine between Gunnison Bay and Gilbert Bay. Also, very little if any information is available as to the non-point contribution of nutrients to both Gilbert Bay and Gunnison Bay.

These examples clearly show the limits of available nutrient data and the uniqueness of the hypersaline biotopes of Great Salt Lake, thereby making it very difficult to use existing research of typical aquatic environments as a point of reference to assess the water quality criteria of Great Salt Lake with regard to nutrients.

D. Brine shrimp from Great Salt Lake must be recognized as protected aquatic wildlife.

Brine shrimp from Great Salt Lake are either mentioned as a key stone species and as a food source for birds (Strategy page 6, lines 151 through 155) or as an important economic species with an important commercial value to the local economy (Core Component 1, page 11, lines 288 through 297). These statements are true, but fail to account for the very important fact that Brine shrimp from Great Salt Lake are considered protected aquatic wildlife and, as such, are tightly monitored and controlled by the Utah Division of Wildlife Resources. Administrative Rule R657-52-11 specifically identifies brine shrimp as a “Species of Protected Aquatic Wildlife”. Brine shrimp need to be recognized as fundamentally essential to the ecosystem of the Great Salt Lake and that their protection be based on the fact that they are already designated as protected aquatic wildlife, in addition to, and independent of, their critical ecological functions.

E. The water quality strategy fails to mention the true worldwide ecological importance of Brine Shrimp from Great Salt Lake.

On page 2 of the Strategy, lines 22 and 23, it mentions the hemispheric importance of Great Salt Lake because it is a refueling stop for millions of migratory birds. Brine shrimp, although mentioned as a keystone species, are merely referred to as a food source to birds, on par with brine flies, or as a harvested species used worldwide in aquaculture (Strategy, page 6 lines 151 through 155). The Strategy fails to mention the true worldwide ecological importance of Great Salt Lake as a result of its significant and stable population of the brine shrimp species *Artemia franciscana.*

Great Salt Lake remains the single largest natural production site of *Artemia franciscana* in the world. The significance of this statement, and consequently the global role of Great Salt Lake *Artemia franciscana*, must be strongly emphasized and fully understood.

The pivotal role of the Great Salt Lake *Artemia franciscana* is truly of vital global importance. The Great Salt Lake Artemia resource is the foundation for global marine protein production and necessary to feed the world's growing population. Protein production and availability in human diets is severely limited in many parts of the world, resulting in an expanding protein crisis. The blossoming aquaculture industry is addressing this serious demand for protein production and the Great Salt Lake *Artemia* cyst production serves a key role for this purpose.

Great Salt Lake *Artemia* are a key food source in the rearing of larval marine fish and shrimp at the hatchery level. One of the clear ecological benefits of aquaculture production of marine fish and crustaceans has been a reduction in the harvesting pressure on wild stocks of fish. The aquaculture industry continues to ease the demand on wild stocks through judicious and efficient farmed production of fish and crustaceans. Great Salt Lake *Artemia* has been a highly important factor in this systematic replacement of farmed species for wild strains in the marketplace.

It is also believed that the geographic distribution of *Artemia franciscana* throughout smaller hypersaline habitats in North and South America occurred through involuntary distribution by migratory birds. *Artemia franciscana* within those habitats also play important local ecologic roles. Because the Great Salt Lake features a much larger and more stable natural production source for *Artemia franciscana,* it serves as a reliable source population for the inoculation of *Artemia franciscana* throughout saline lakes in North and South America, and as such is also of specific hemispheric importance.

As described in the Strategy (page 6, line 151 through 154), brine shrimp from Great Salt Lake are mentioned as a keystone species and as a food source for birds. Nowhere does it emphasize the extremely efficient capability of the brine shrimp to consume micro algae and thus efficiently prevent the eutrophication of Gilbert Bay. Based upon the size of the Artemia population, it may also be the single largest dietary contributor to higher trophic levels supported by Great Salt Lake.

These examples clearly demonstrate the true ecological and the local, hemispheric and global importance of Great Salt Lake brine shrimp, *Artemia franciscana.*

F. The water quality strategy also fails to mention the true worldwide economic importance of brine shrimp from Great Salt Lake.

In Core Component 1 page 11, lines 288 through 297, under the title "Ancillary Benefits for Commercial Brine Shrimp Uses," the commercial value of brine shrimp to the local economy is specified. The economical benefits of brine shrimp to the local economy are true and very important. However, the Strategy does not emphasize the global economic importance of *Artemia franciscana* from Great Salt Lake.

Throughout the last 40-plus years, Great Salt Lake *Artemia* with its particularly desirable nutritional and morphological characteristics, have been one of the most critical factors supporting the global production of marine fish and crustaceans. The growth of this industry (and its critical contribution to meeting global protein demands) would have been severely impaired without the availability of Great Salt Lake *Artemia franciscana* as a live food source.

G. In "APPENDIX 1: ONGOING ACTIVITIES RELATED TO STRATEGIC PLANNING EFFORTS", It should be specified that the elevated methyl mercury levels found by the Unites States Geological Survey (Naftz et al., 2008) were only found in the deep brine layer and are not representative of the upper trophic levels which represent the vast majority of Gilbert Bay.

The Great Salt Lake Water Quality Strategy Appendix 1 (page A-3, lines 646 through 672) leads one to believe that the methyl mercury concentrations in the main body of Great Salt Lake are some of the highest recorded in the United States. Naftz et al., 2008 reported on elevated mercury levels that were derived from samples taken from the deep brine layer of Gilbert Bay. The deep brine layer is only a fraction of the total volume of Gilbert Bay and is by no means functionally representative of all waters of Gilbert Bay. In fact, subsequent sampling has found mercury concentration in the "shallow brine layer" to be well within the EPA standard for salt water. Starting the paragraph with a statement that implies, to the uniformed reader, that all of the waters of Gilbert Bay are contaminated with high levels of methylmercury is misleading and inaccurate (and it is potentially damaging to the local brine shrimp industry). By not articulating clearly that the elevated levels are only found in the deep brine layer, and not in the upper mixed zone of Gilbert Bay, the information falsely represents the actual conditions in Gilbert Bay and, as such, results in great harm to the reputation of the Utah brine shrimp industry, which exports the majority of its products worldwide. Dating back to 1993, the local brine shrimp industry has collected *Artemia* samples and analyzed them for mercury contamination. The resulting data do not indicate an increase in mercury levels in *Artemia* cysts from 1993 until present.

Please contact Thomas Bosteels at thomas@gsla.us with questions or for additional comments or information.