Rubric for Salinity Objectives

Great Salt Lake Salinity Advisory Committee, July 27, 2023

What do we know?

- The USGS collects water samples and computes salinity on a monthly interval from three depths (0.5m, 3m, and 5m) at four locations in the South Arm as part of GSLEP's monitoring program. Results from this monitoring program will be used for decision making.
    - Other groups also compute salinity as part of different monitoring programs, however, their data will only be used to inform the understanding of GSL salinity dynamics and not be used for decision making.
- The salinity of the upper brine layer can vary spatially, vertically, and temporally.
    - The observed salinity in the upper brine layer is an integration of in situ upper oxic brine layer water, fresh and brackish water inflows to Gilbert Bay, and deep anoxic brine layer waters and is subject to water level, winds, lake currents, and currents induced by inflow rates.
    - USGS study (Christine Rumsey's latest – in review) indicates that the salinity at 0.5m is generally consistent across the South Arm except during the spring runoff season.
    - Although it can be influenced by spring inflows to the lake, salinity at 3m is generally more seasonally and spatially consistent than at 0.5m across the South Arm.
    - Conjecture indicates that shallow, less saline waters (such as from freshwater inflows) are more apt to mix with the upper brine layer than the anoxic, high salinity deep brine layer.
- The critical endpoint in the spring is hatchability success for artemia cysts.
    - Cysts generally require a salinity of less than 130 g/L to successfully hatch; a salinity of less than XXX g/L is optimal (Sorgeloos et al 1986; Browne & Wanigasekera 2000).
    - Artemia cysts are thought to not be able to hatch in the anoxic, high salinity deep brine layer. Thus, the target salinity of less than 130 g/L in the spring applies to the upper brine layer.
- The critical endpoint in the fall is survivability of brine flies and microbialites.
    - Available data indicate that brine flies and microbialites require a salinity of less than 160 g/L. Salinities of higher than 160 g/L are detrimental to these organisms.
- See the salinity matrix for other salinity responses and consequences.

Thus,

Spring salinity objective

The spring salinity objective is a salinity of less than 130 g/L in the upper oxic brine layer. This will be computed as a volume-weighted concentration for samples collected above the deep anoxic brine layer and averaged across all four USGS sampling points included in GSLEP's program.

- This value will generally be considered and reported as the salinity of the South Arm as it is what most of the uses of Great Salt Lake rely upon.
- The minimum spring salinity computed annually per the above during the period of December – June will be used for decision making. Rationale is as follows:

    - The salinity of the upper brine layer is the metric most indicative of artemia hatchability success.
    - It is assumed that fresh/brackish water inflows to Gilbert Bay are critical to the desired spring salinity in the upper brine layer. These inflows largely influence the most shallow water samples and should be included in the calculation as they are most readily mixed with and will influence the insitu upper brine layer.
    - The deep anoxic brine layer, when present, can influence the salinity of the upper brine layer but to a lesser extent. Further, artemia cysts in the anoxic deep brine layer are most likely not going to hatch. Thus, the salinity of the anoxic deep brine layer will not be included in this calculation.

However, a fully integrated salinity for the water column (including both the upper and deep brine layers) will be computed as a volume-weighted concentration and averaged across all four USGS sampling points included in GSLEP's program.

- This fully integrated water column (all depths) salinity computed for the spring period will not be used to make decisions but will be helpful to understand the state and dynamics of the system.
- These values will be used to annually estimate and monitor the salt mass of Gilbert Bay and evaluate the flux of salt with the North Arm during the period of January – June.

Fall Salinity Objective

The fall salinity objective is a salinity of less than 160 g/L computed as a volume-weighted concentration for all depths (that is, including the potential deep brine layer) and averaged across all four USGS sampling points included in GSLEP's program.

- The maximum salinity computed annually per the above during the period of July - November will be used for decision making. Rationale is as follows:
    - It is understood that the salinity of the upper oxic brine layer is the critical endpoint for ecological and industrial uses of the lake, however, the integrated salinity of the entire water column is the metric most useful for salt mass monitoring and evaluation, most indicative of the salinity trend of the South Arm, and most important in making salinity management decisions pertaining to salt mass flux.
- A salinity computed as a volume-weighted concentration for samples collected above the deep anoxic brine layer and averaged across all four USGS sampling points included in GSLEP's program will still be computed, monitored, and used in communicating the salinity of the South Arm. The upper brine layer salinity will not, however, be used solely as the fall salinity objective for decisions.

These values and protocol will be evaluated at the end of each calendar year and modified as appropriate.

References

Browne R.A., and G. Wanigasekara. 2000. "Combined effects of salinity and temperature on survival and reproduction of five species of Artemia". J Exp Mar Biol Ecol 267:107–119.

Sorgeloos, P., et al. 1986. "Manual for the culture and use of brine shrimp in aquaculture." Belgium. Ghent University. 319p.