GREAT SALT LAKE SALINITY MATRIX 2021

Salinity (g/L) — Saturation

Historical Salinity Ranges for Lake Elevation > 4193 ft (NVGD 29) (g/L)	
	Gunnison Bay (North Arm)
	Gilbert Bay (South Arm - Upper Brine Layer)
	Gilbert Bay (South Arm - Deep Brine Layer)
	Farmington Bay
	Bear River Bay

South Arm - Upper Brine Layer
1966-2020: Range 48-295, **Avg: 134**
2011-2020: Range 110-188

South Arm - Deep Brine Layer
1966-2020: Range 106-338, **Avg: 212**
2011-2020: Range 134-210

North Arm
1966-2020: Range 167-362, **Avg: 296**
2011-2020: Range 271-353

ECOSYSTEM SUMMARY

Great Salt Lake Salinity and Impacts on Biology (Baxter 2020)	Heterotrophic Bacteria A
	Heterotrophic Archae
	Benthic Photosynthetic Communities (e.g., microbialites) B,C
	Water Column Photosynthetic Communities C,D
	Fungi
	Protists
	Ephydra spp. (brine flies) E
	Artemia Franciscana (brine shrimp) C
	Trichocorixa spp. (corixids)
	Avian species F

ECOLOGICAL USES

Benthic Algae	Significant change in benthic biomass in Mono Lake at 50ppt, Reduction in periphyton chlorophyll a biomass and twice the diatom diversity 20
Algal Impacts	Observed decline in salinity altered phytoplankton community to diatoms and thus Artemia 14
	Harmful Algal Blooms (Nodularia spumigena) 32
	Algal biomass increases from 30 - 150 g/L 33
	Algal biomass is limited by increasing salinity 19
Micro-bialites	Effect of salinity diminishes (25-60ppt) but facts important, Microbialites thrive (60-150ppt), other factors (eg, nutrients) may be influential 27
	Abundant growth at 120ppt, no microbialite growth observed at 250ppt 28
Brine Flies	Ephydra packardi, best growth 40-50ppt, cannot survive above 90ppt 22,23
	Ephydra hians, best growth 25-100ppt, alkaline carbonate waters 23
	Ephydra gracilis, best growth 100-200ppt, chloride waters 23
Artemia Salinity Tolerance	Artemia salina survived 1
	Artemia die close to NaCl Saturation (>250ppt) 2
	Optimal Hatching (5-35ppt) 2
	Up to 310 pt for A. urmiana (34.6%) and A. parthenogenetica (18.8%) 3
	Max salinity close to 340 g/L 4
	GSL Observations (5 - > 260ppt) 5
Artemia Maturation & Repro-ductive Success	Pronouced reduction maturation/survival rates at 170ppt for smaller instar stages 6
	Brood size decrease with increasing salinity and hatching fails: 159ppt, Tolerance for A. monica subadults is between 159-179ppt 7
	High offspring for A. franciscana: 120-180ppt with max at 120ppt 8
	Max life span/% of embryos produced: 120ppt, major crashes (never reached maturity) at 160-200ppt A parthenogenetica 9
	Significant drop in reproductive success above 160-170ppt 5
Artemia Survival Rates	Reduced survival of Nauplii instar stages > 150ppt 6
	Survival decreased with salinity, salt tolerance for A. monica sub adults is 159-179 pt 7
	Sharp decline in survival: 180ppt, significant decline at 140ppt, optimal at 100-140ppt 10
	Stress tolerance increased above 80ppt 9
	Significant reduced survival between 140-180ppt 5
Artema Physio-logical Charac-teristics	Critical oxygen tension in chloride waters at 170ppt, exceeded at 210ppt 11
	> 150 ppt exerts pronounced impact on adult Artemia 10
	60% decrease in A. franciscana from GSL from 75 to 225ppt, Artemia doesn't tolerate salinties above 225ppt 12
	Stress tolerance increased above 80ppt 9
	Critical reduction in physiological processes beyond 150-170ppt 5
Optimal Salinity at Artemia Population Level	Between 150-180ppt sharp decline in maturation/reproductive success, survival, population level growth 5
	Significant population level decline: from 180-300ppt 5
	Very significant drop in GSL Artemia population size above 16-170ppt and below 85-90ppt 5, 19
Corixids	Corixids found in Gilbert Bay, 1997 at 114ppt 14
	Corixids survive to 150 ppt, population constrained at 90-100ppt 16
	GSL Brine Shrimp Cooperative observed corixids in Gilbert Bay to 120ppt 5
	Trichocorixa verticalis, observed limit for growth: 80-100 g/L 21
	Trichocorixa verticalis are found to thrive at 20 - 60 g/L 15, 29
	Sharp decline for Trichocorixa verticalis at 60 g/L, few at 90 g/L 15
	Mortality for Trichocorixa verticalis at 55-70 g/L, most lethal at 70 g/L 30
	Maximum salinity tolerance for Trichocorixa verticalis at 90 g/L 31
Corixids & Predation Upon Artemia	A. franciscana population density fell below 1/l dur to corixids 13
	Significant impact of corixids on Artemia structure up to 90-100ppt 16,17,18
	Critical salinity threshold to prevent corixid predation is 90-100ppt 5
Birds	Shorebirds, abundance 120-140ppt 26 fewer birds at salinity > 180 g/L 21
	Indirect effects on birds from diet
Fish	Rainwater killifish near Stansbury Island 34
	Bear River Bay, Willards Spur, Farmington Bay 35
Vegetation	Emergent aquatic vegetation
	Submerged aquatic vegetation 36

INDUSTRIAL USES

	Brine Shrimp Harvest 5
	Mineral Extraction (South Arm)
	Mineral Extraction (North Arm)

IDEAL — UNFAVORABLE

Salinity (g/L)

1 Croghan 1957
2 Sorgeloos et al , 1986, Lavens and Sorgeloos 1996
3 Mohammadi et al 2009
4 Gonzalo and Beardmore 2012
5 Bosteels 2012
6 Wear et al. 1986
7 Dana and Lenz 1986
8 Browne & Wanigasekera 2000
9 Abatzopoulos et al 2003
10 Triantaphyllidis et al 1995
11 Decleir et al 1980
12 Barnes and Wurtsbaugh 2015
13 Wurtsbaugh and Berry 1990
14 Stephens 1998
15 Mellison 2000
16 Herbst 2006
17 DeMeutter et al 2010
18 Tanner et al 2014
19 Belovsky et al 2011
20 Herbst and Blinn 1998
21 Herbst 2006
22 Ping 1921
23 Herbst 1999
24 Por 1980
25 Harbst 2001
26 Warnock et al 2002
27 Anderson et al 2020
28 Lindsay et al 2017
29 Hammer et al 1990
30 Kertz 1979
31 Hammer 1986
32 Jacobs 2018
33 Belovsky 2005
34 Associated Press 1986
35 Penne 2012, Edwards 2021
36 Steward and Kantrud 1972, Kantrud 1990

A. Includes potentially harmful cyanobacterial blooms, but only at the 10-50 ppt salinity range
B. Microbialite-associated
C. Includes both bacterial and eukaryotic photosynthesizers
D. Dunaliella salina and Tetracystis spp are prevalent in the north arm, no evidence of other eukaryotic algae, so diversity is limited.
E. Predation by Trichocorixa spp. at lower salinities
F. Avian diets are particular to the species and will be tied to the success of their food source, which is controlled by salinity. The high salinities provide little in food source, but much in protection (e.g. American White Pelican colony on Gunnison island), which is tied to lake level and not salinity.

All data cited in: Baxter, B.K and Butler, J.K., Eds. Great Salt Lake Biology: A Terminal Lake in a Time of Change. Springer, Cham, 2020.

GSL SALINITY ADVISORY COMMITTEE