Hypersaline Environments

Ideal for cyanobacteria and other phototrophic bacteria as the primary producers (photoautotrophs) with many dependent non-photosynthetic Bacteria and Archaea (mainly chemoheterotrophs)
Halotolerant
Example: *Staphylococcus aureus*

Halophile
Example: *Vibrio fischeri*

Extreme halophile
Example: *Halobacterium salinarum*

Nonhalophile
Example: *Escherichia coli*

Optima 0.5-2M

(seawater ~ 0.44 M = 30.2 g/L) NaCl

(2M (137 g/L))

(5M (342 g/L))

Optima > 3M
(205 g/L)
SALINE ENVIRONMENTS

Some terms:

Brines = Concentrated solutions of ions

Evaporites = minerals precipitated from solution as a result of the evaporation of water

Thalassic = waters or salts of marine origin

Athalassic = waters or salts of non-marine origin
Order of precipitation of salts \textit{(from seawater)}:

- Calcite $\text{CaCO}_3$
- Gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
- Halite $\text{NaCl}$
- Sylvite $\text{KCl}$
- Carnallite $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

Salts of greater solubility than KCl: $\text{MgCl}_2$ (Bischofite), $\text{CaCl}_2$ (Antarcticite)
dry intertidal Lyngbya mat, G.N.

c.a. 55 ppt
Lyngbya
(fixes N at night-no heterocysts)

Purple S bacteria
Cerithidea californica feeding on Microcoleus mat after seawater influx
Calothrix, G.N.
(higher in intertidal than Lyngbya, has heterocysts-daytime N-fixation)
Pond 4, G.N. ~ 80 ppt salinity with cyanobacterial mat (yellow & dark)
Cyanobacterial mat of *Microcoleus* on top, showing purple sulfur bacterial layer underneath.

~ 60 g/L salinity

From hypersaline pool, G.N.
Section of microbial mat from Pond 4, G.N.; ~ 80-90 ppt

Cyanobacterial layer
Two common cyanobacteria from submerged G.N. hypersaline mats from Pond 4

*Spirulina*

*Oscillatoria*

*5 µm*

Migrating spp.
Micobial mat from > 100 g/L salinity; cyanobacteria on surface, *Chloroflexus*-like bacteria below
Cyanobacteria sp. with high carotenoid

high chlorophyll sp.

Mat from Pond 8, G.N.
Cyanobacteria with high carotenoids

with high chlorophyll

Ephemeral mat in mangrove lagoon, seawater ~ 35 g/L
Gypsum precipitated, Pond 9, G.N.

With Artemia
Cyanobacterial zone within gypsum crust; Pond 9, G.N. (>150 g/L)
“Halobacteria” (red-orange) in shallow pond, G.N.
Natural salina, G.N. with “halobacteria” and Dunaliella