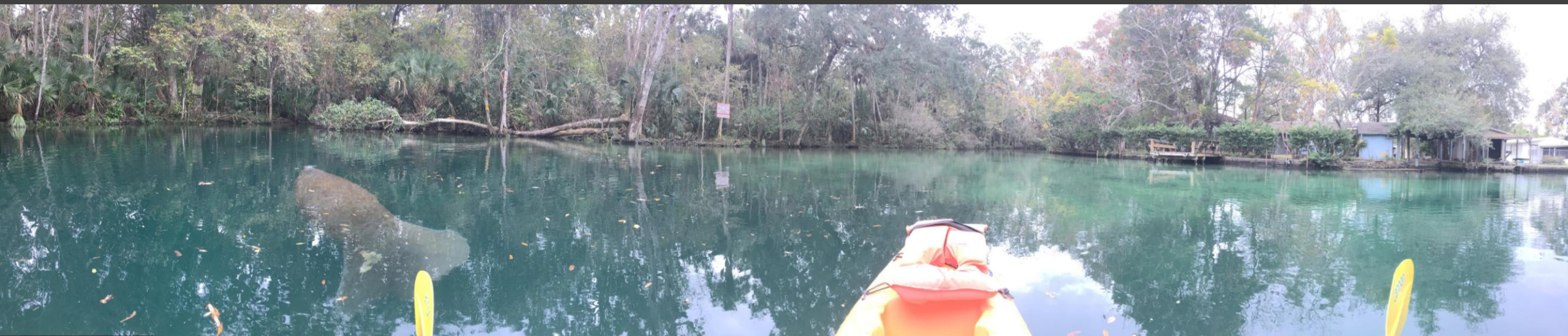
Hospital Hole: a window into subsurface microbial communities

Madison Davis, Ph.D.
Springs Scientist, SWIM



water

MDPI

Article

Microbial Function and Hydrochemistry within a Stratified Anchialine Sinkhole: A Window into Coastal Aquifer Interactions

Madison C. Davis and James R. Garey *

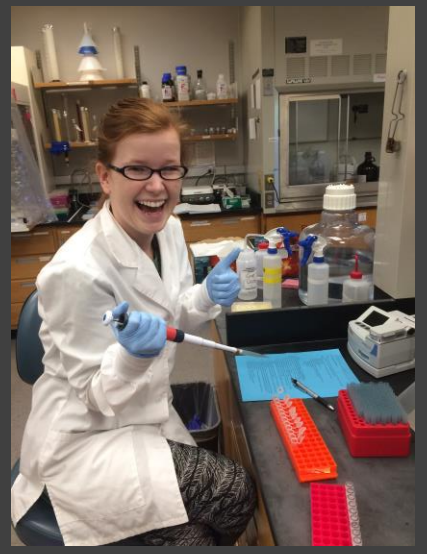
Department of Cell Biology, Microbiology and Molecular Biology, University of South Florida, Tampa, FL 33601, USA; madison7@mail.usf.edu

* Correspondence: garey@usf.edu; Tel.: +1-813-974-0949

Sample Collection and Analysis

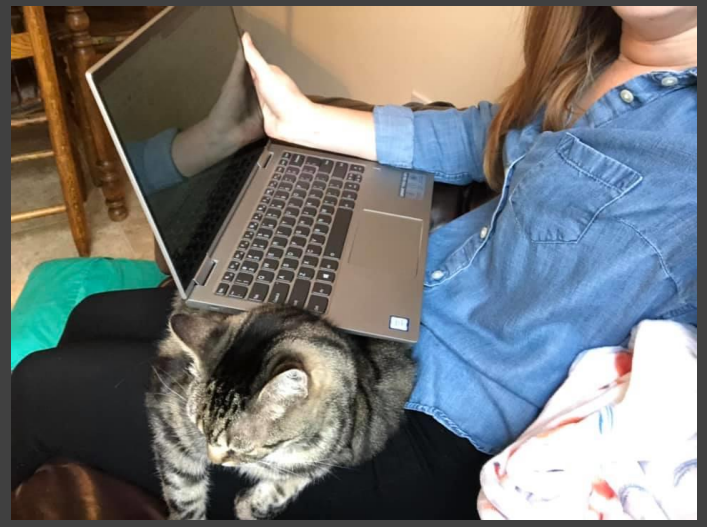
Sample collection

Hydrochemical analyses and filtration

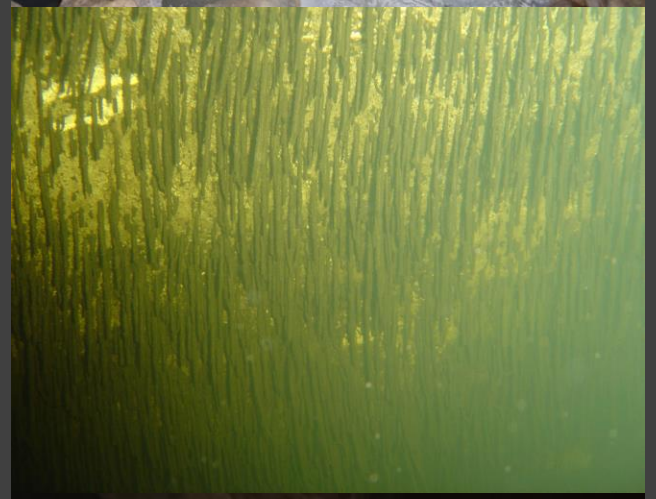


DNA extraction

Polymerase chain reaction and 16S rRNA Illumina sequencing



Bioinformatics

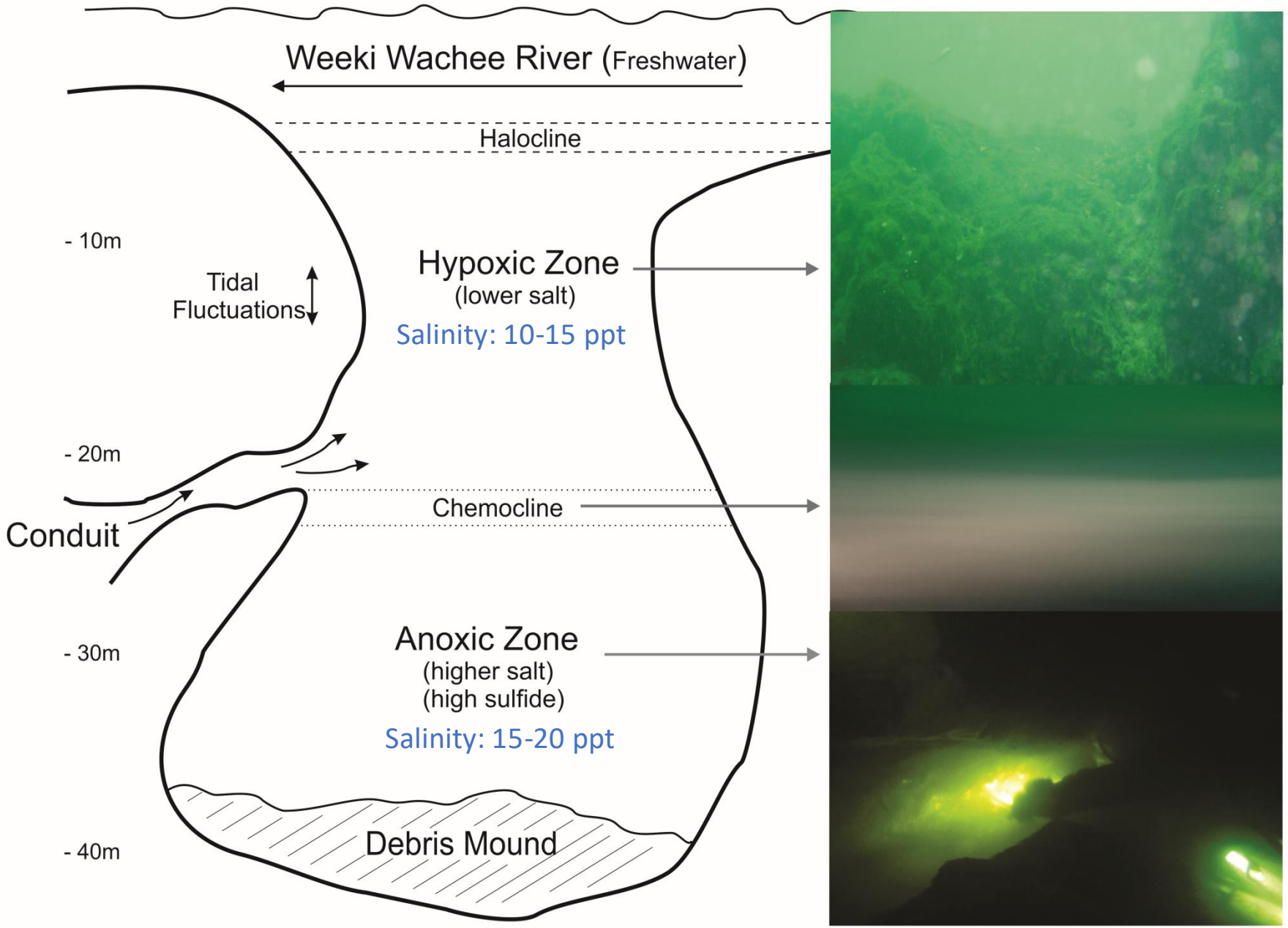


Subsurface microbial ecology

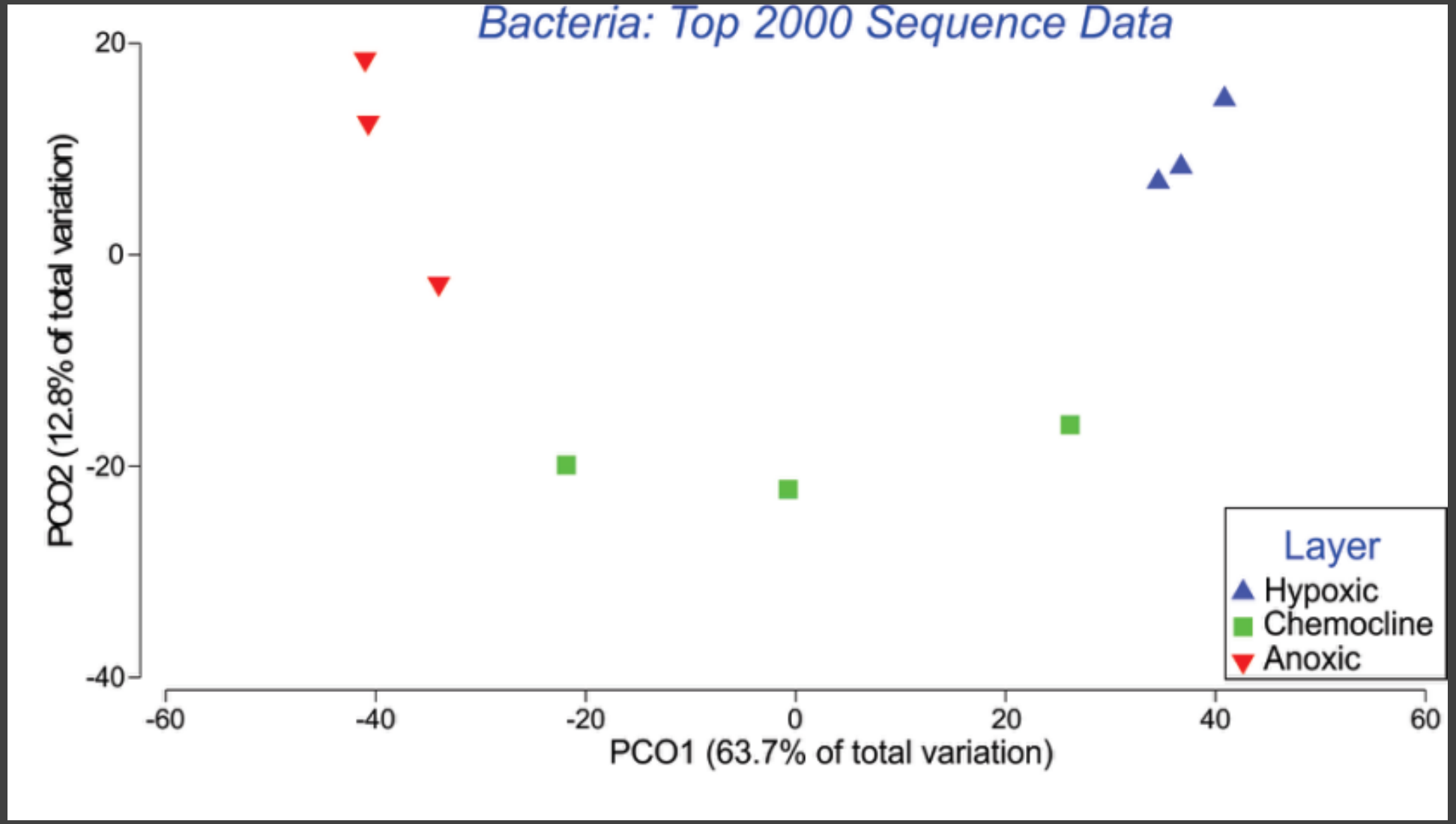
- Bacteria are a major component of subsurface
- Perform a lot of important roles
  - Chemosynthesis (biogeochemical cycling)
  - Food webs
  - Speleothem formation
  - Groundwater purification
- Poorly characterized
- *Do different groundwater zones impact subsurface microbial communities?*

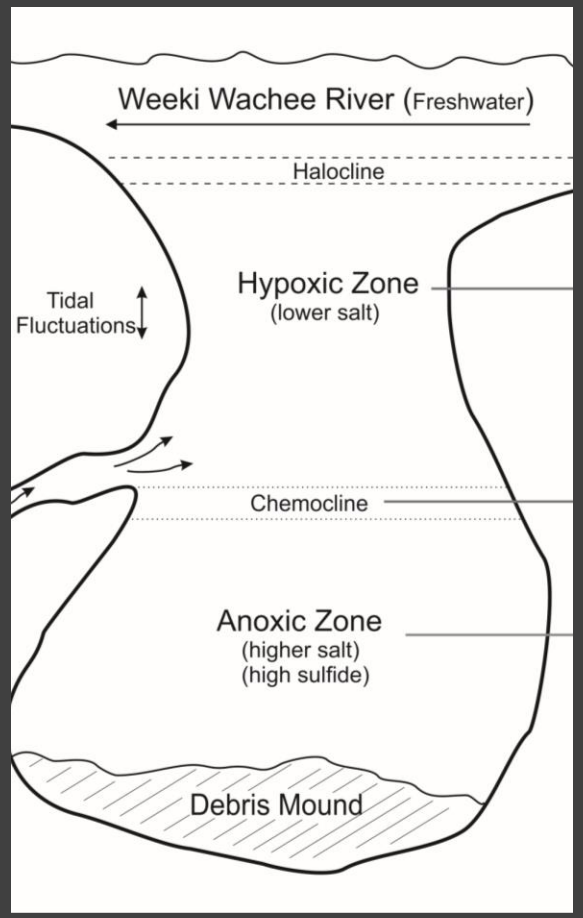
Hospital Hole Weeki Wachee, FL

year-round stratification


Weeki Wachee River (Freshwater)
Halocline
- 10m
Tidal
Fluctuations
Hypoxic Zone
(lower salt)
Salinity: 10-15 ppt
- 20m
Chemocline
Conduit
- 30m
Anoxic Zone
(higher salt)
(high sulfide)
Salinity: 15-20 ppt
Debris Mound
- 40m

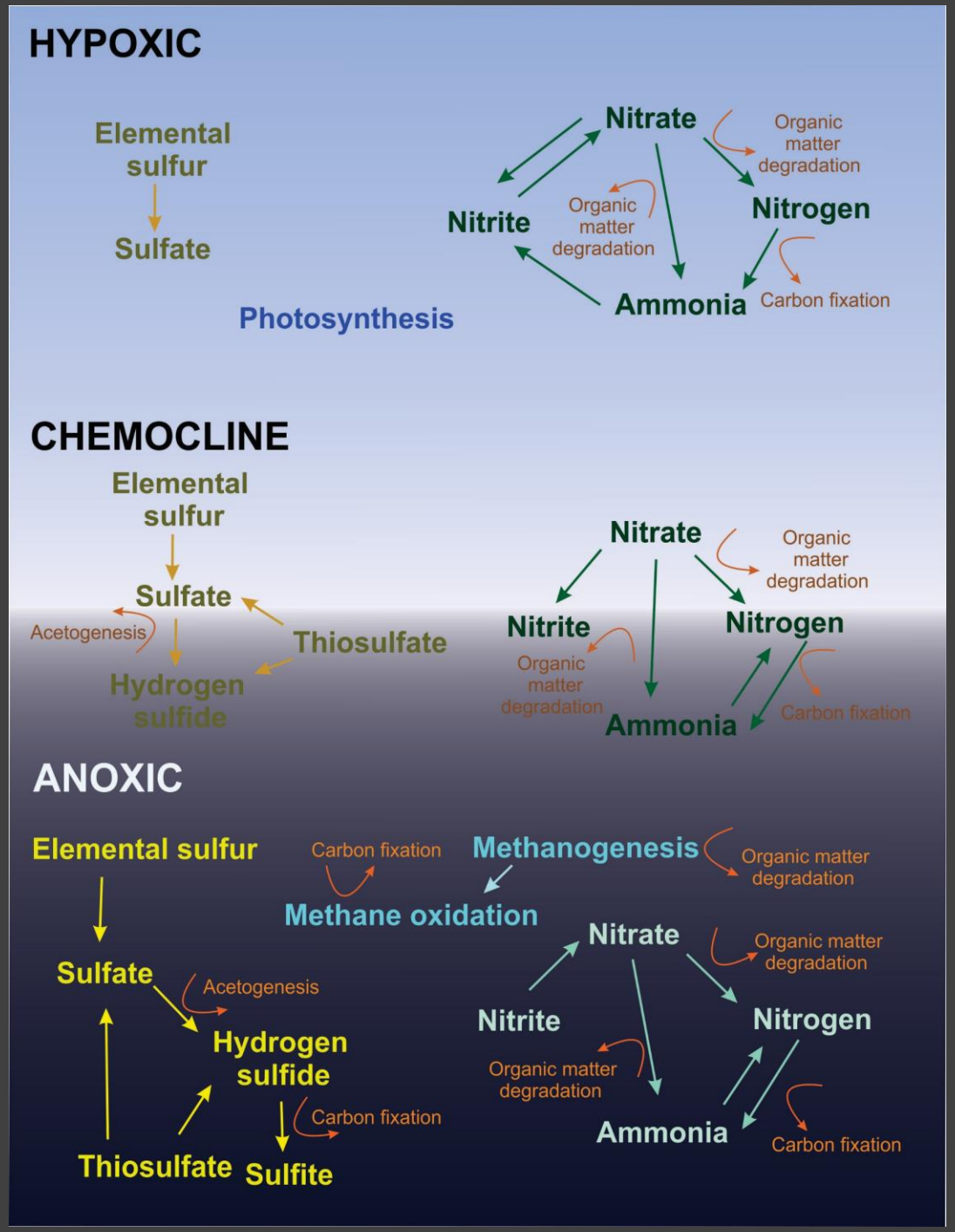
Microbial communities





Bacteria

Name	Hypoxic	Name	Chemocline	Name	Anoxic
Halioglobus	15033	Sulfurimonas	10604	Sulfurimonas	12659
Escherichia	2994	Halioglobus	10264	Escherichia	2433
Arcobacter	782	Arcobacter	5757	Unknown	1434
Sulfurimonas	703	Alkalilimnicola	1023	Desulfocapsa	1144
Prochlorococcus	182	Emcibacter	366	Christensenella	745
Oceanicola	148	Unknown	344	Lentimicrobium	624
Emcibacter	136	Desulfocapsa	275	Arcobacter	565
Alkalilimnicola	129	Escherichia	204	Erysipelothrix	469
Rhodobacter	109	Lentimicrobium	133	Desulfosarcina	354
Citreicella	87	Sulfurovum	129	Mariniphaga	304
Thalassobius	84	Christensenella	76	Candidatus Aquiluna	276
Unknown	56	Desulfosarcina	71	Anammoximicrobium	245
Clostridium	46	Thalassobius	65	Ornatilinea	168
Citreimonas	41	Prochlorococcus	51	Claocimonetes	158
Methylotenera	32	Erysipelothrix	48	Sulfurovum	156
Desulfocapsa	30	Mariniphaga	48	Desulfotalea	155
Hypnocyclicus	28	Candidatus Aquiluna	42	Thermomarinilinea	140
Pelobacter	26	Dissulfuribacter	40	Sphingobacteriia	139
Lentimicrobium	25	Citreicella	40	Nibribacter	129
Streptococcus	22	Draconibacterium	34	Dissulfuribacter	126
Dechloromonas	22	Anammoximicrobium	33	Cryobacterium	117
Nitrospina	18	Cytophaga	29	Pelolinea	112
Psychrobacter	17	Lutibacter	28	Draconibacterium	104
Thiobacillus	13	Citreimonas	28	Cytophaga	100
TOTAL	20764	TOTAL	29731	TOTAL	22855



- Sulfur and nitrogen cycling dominant
- Some pathways not present
- Microbial communities and functions related to geochemistry
  - *Alkalilimnicola*: nitrite 20x higher in chemocline
- Only part of the story
- Approximation of aquifer

Key takeaways

- Unique microbial communities occur in different groundwater regions
- Microbial communities and geochemistry are related
- The aquifer is not homogenous, impacted by land use
- Microbes can be used to identify pollutants
- Aquifer is complex

Madison.Davis@swfwmd.state.fl.us