Water metagenomics analysis of La Brava and La Punta lake system in the Chilean Atacama Desert

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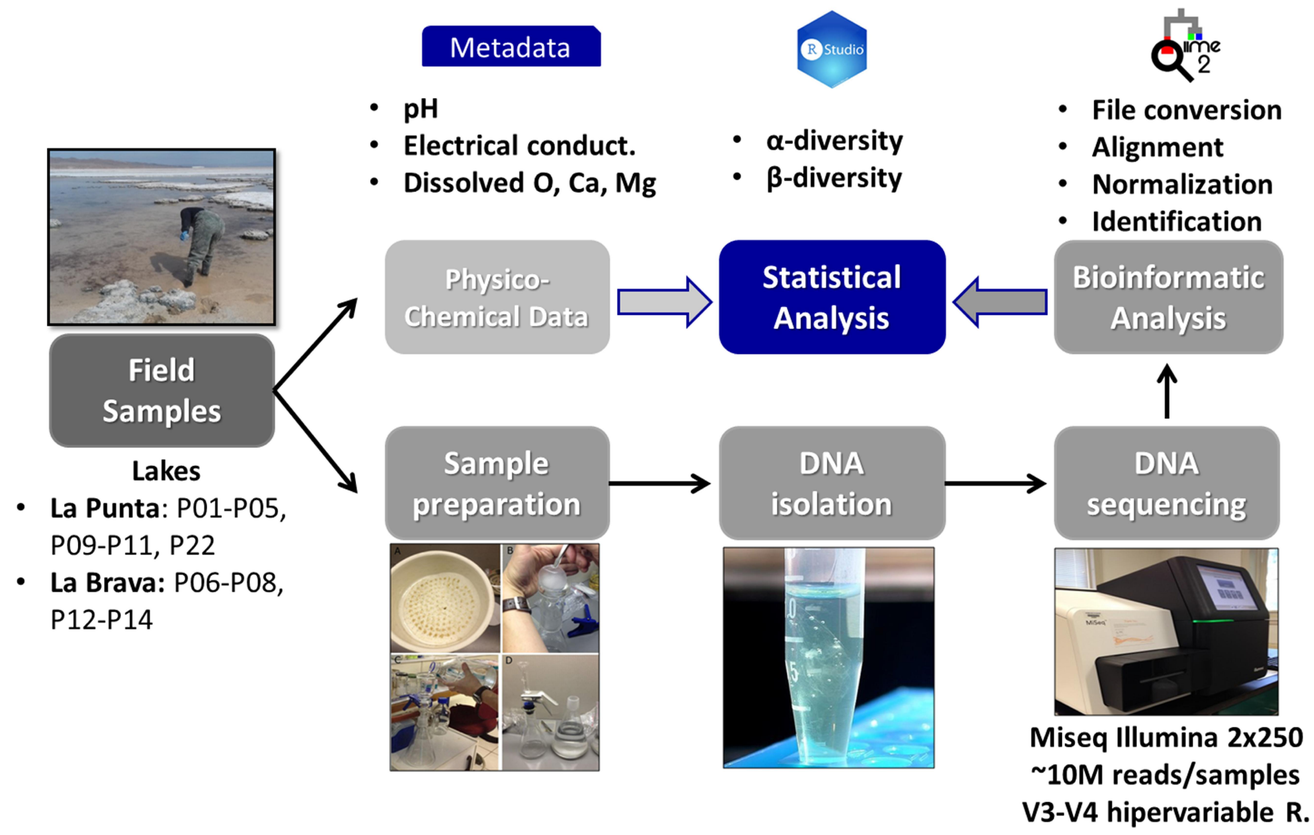
1. Background

High altitude Andean Lakes (HAALs) are found along the central Andean of South America. All 52 HAALs present in Chile are distributed along the Atacama Desert. Among these, the salt lake system of La Brava and La Punta are located in the southern sector of Tilopozo in the Salar of Atacama (Antofagasta region). These lakes are located in a hyper arid environment in which extremophile microorganisms grow and flourish[1]. These extremophile posses broad and versatile physiological capacities for surviving under extreme environmental conditions and low nutrition availability[2].

2. Objective

The main objective was a metagenomic analysis using 16S rDNA to characterize the taxonomical composition of the lake system and to determine which physicochemical parameters affect the microbiome composition.

3. Material and Methods



4. Results

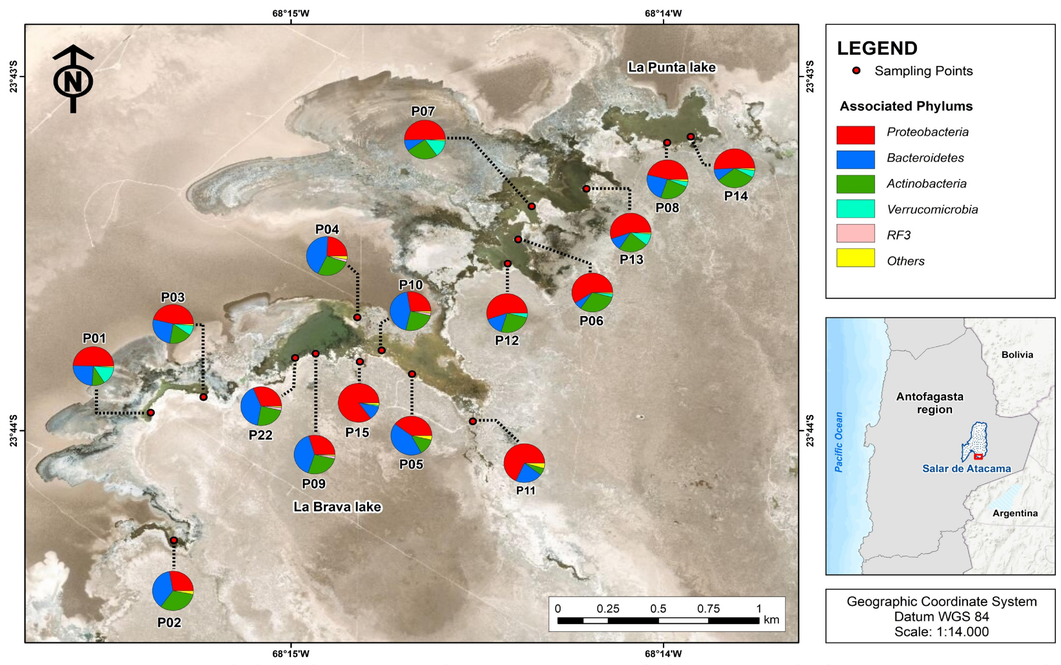


Figure 1. Spatial distribution and composition of the main Phyla in La Brava and La Punta Lakes. The 6 main phyla for each sample point are represented in each pie chart. Classification "Others" represents 44 minor phyla also detected in the lake system. Red square indicates the location of La Brava and La Punta lakes within the Salar of Atacama.

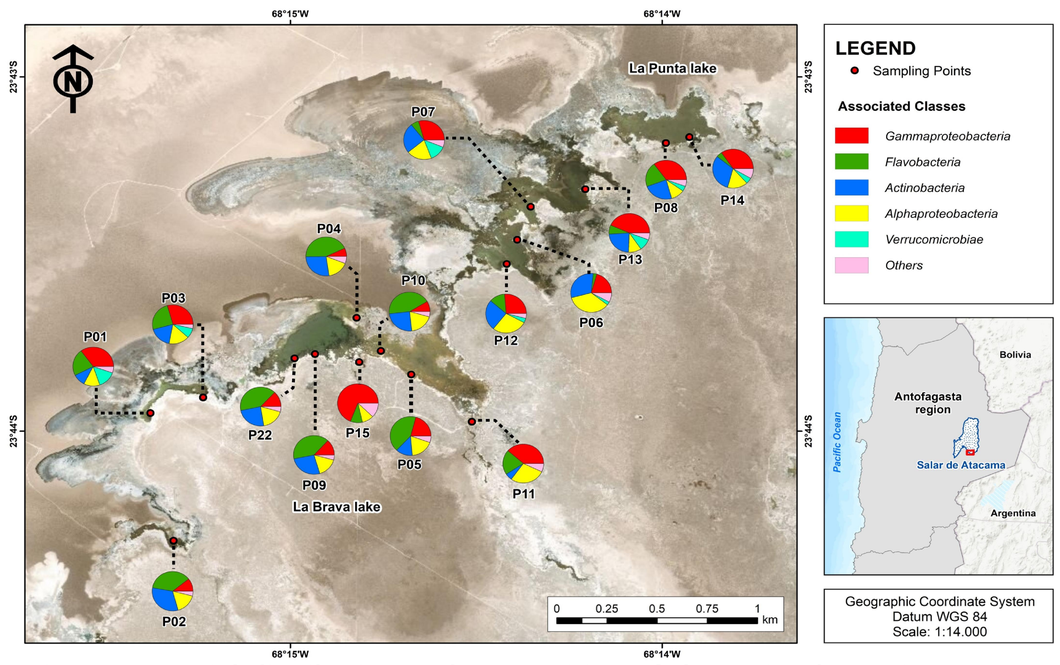


Figure 2. Spatial distribution and composition of the main Classes in La Brava and La Punta Lakes. The 6 main classes for each sample point are represented in each pie chart. Classification "Others" represents 121 minor classes also detected in the lake system. The red square indicates the location of La Brava and La Punta lakes within the Salar of Atacama.

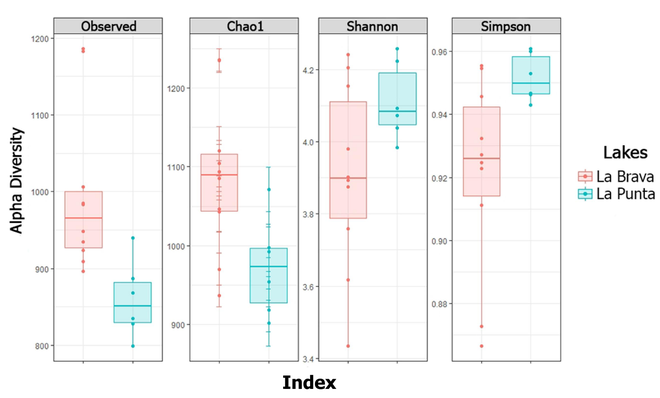


Figure 3. Alpha Diversity index for each lake. Alpha diversity was calculated by using 3 different index. The Shannon index mean for La Brava is 3.91 and for La Punta, 4.11.

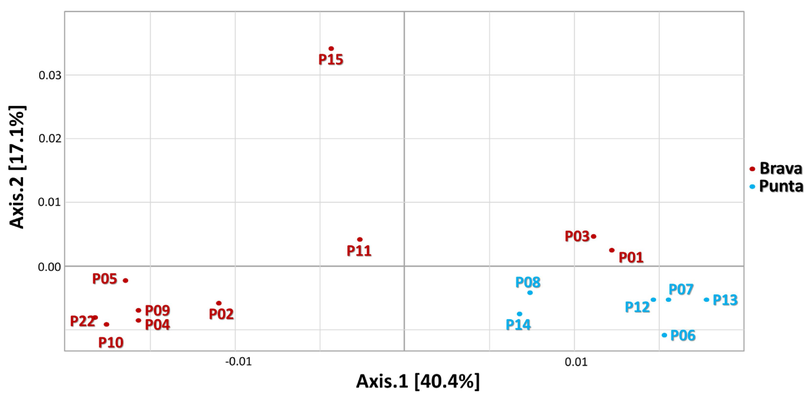


Figure 4. Beta diversity. Beta diversity was calculated using a Principal Coordinate Analyzed (PcoA) with the weight unifrac matrix as a covariate and using a Bray-Curtis dissimilarity. Within the plot 57% of the total variance was represented.

Factor	Shannon index					
	Lake system		La Brava		La Punta	
	Pearson	p-value	Pearson	p-value	Pearson	p-value
pH	0.77	0.0004***	0.76	0.0115*	0.61	0.1938
E.C.	-0.55	0.027*	-0.45	0.1908	-0.53	0.2803
Dissolved O	0.31	0.2437	0.26	0.4689	0.7	0.1201
Dissolved Ca	-0.37	0.1562	-0.24	0.5119	-0.27	0.607
Dissolved Mg	-0.39	0.1347	-0.23	0.5303	-0.32	0.5343
Carbonate Alkalinity	0.52	0.0397	0.54	0.1055	0.3	0.5596
Bicarbonate Alkalinity	-0.53	0.0353*	-0.38	0.2768	-0.54	0.2721

Table 1. Correlations between physicochemical parameters and Shannon index (alpha diversity). *: p-value >0.05; **:p-value >0.01; ***: p-value >0.001.

5. Conclusion

- For both lakes the main phyla were Proteobacteria, Bacteroidetes, Actinobacteria, and Verrucomicrobia, in La Brava it was comprised by 42.93%, 33.11%, 18.18%, and 2.56%, respectively. Meanwhile, in La Punta the same phyla were 52.75%, 12.33%, 26.73%, and 6.84%.
- The mean Shannon index was 3.91 for La Brava lake and 4.11 for La Punta lake.
- Alpha-diversity relationships were established with some parameters, revealing the influence of pH within the lake system.

6. References

1. Farías, M. E., Contreras, M., Rasuk, M. C., Kurth, D., Flores, M. R., Poiré, D. G., et al. (2014). Characterization of bacterial diversity associated with microbial mats, gypsum evaporites and carbonate microbialites in thalassic wetlands: Tebenquiche and La Brava, salar de Atacama, Chile. Extremophiles 18, 311–329.
2. Fernandez, A. B., Rasuk, M. C., Visscher, P. T., Contreras, M., Novoa, F., Poire, D. G., et al. (2016). Microbial diversity in sediment ecosystems (evaporites domes, microbial mats, and crusts) of hypersaline laguna Tebenquiche, salar de Atacama, Chile. Front. Microbiol. 7, 1284.

7. Acknowledgement

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