Intra-seasonal trends of cryoconite bacterial communities on an Alpine Glacier

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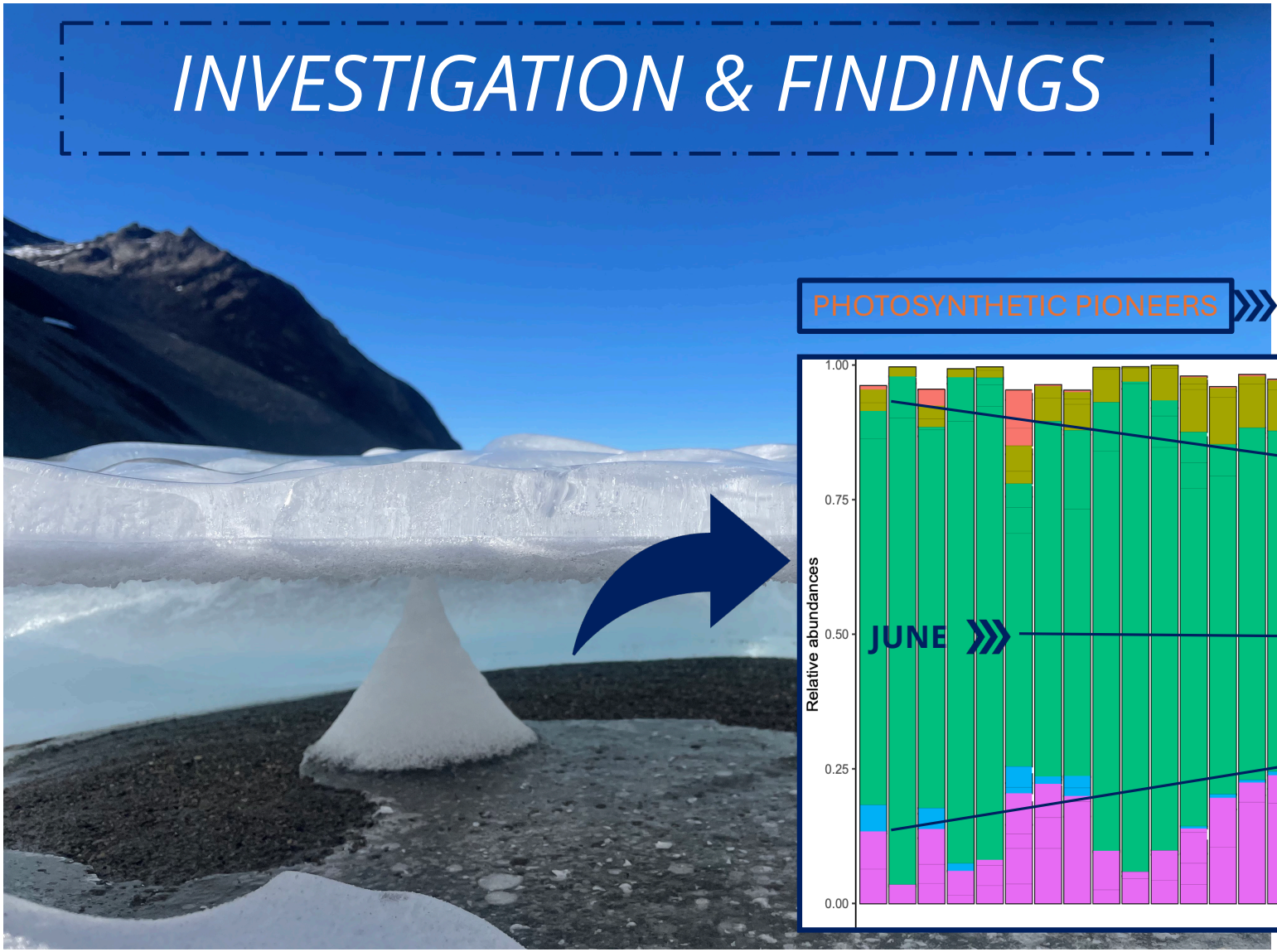
EGU General Assembly 2025 - Session ITS2.12/CR7.6
May 2nd, 2025

INVESTIGATION & FINDINGS



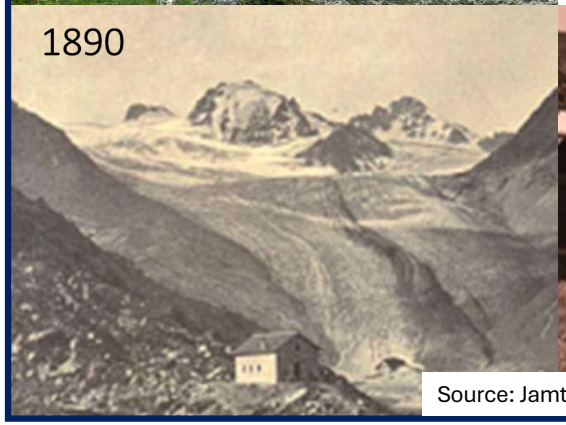
PHOTOSYNTHETIC PIONEERS »» SECONDARY PRODUCERS

HOW DID WE DO THAT?

60 CRYOCONITE HOLES SAMPLED ALONG THE ABLATION SEASON.

WHERE? JAMTALFERNER – REMOTE GLACIER IN THE SILVRETTA ALPS, AUSTRIA.

Source: Wikipedia



Source: Jamtalhuette.at

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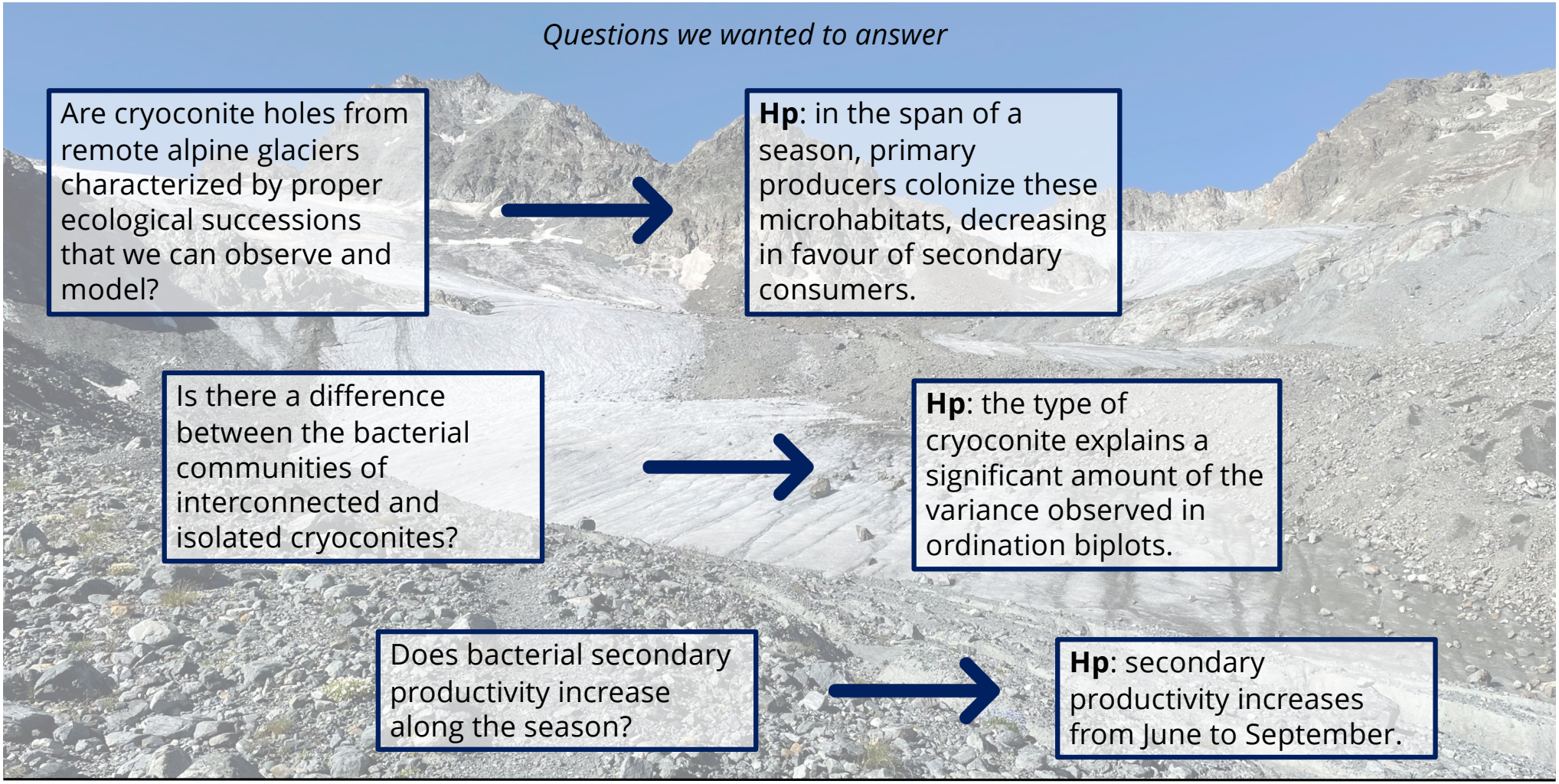
Intra-seasonal trends of cryoconite bacterial communities on an Alpine Glacier – Study Background



Interactive Index ⋙ ***Background*** *Study Area* *Results 1* *Results 2* *Results 3a* *Results 3b* *Discussion*

Intra-seasonal trends of cryoconite bacterial communities on an Alpine Glacier – Study Area

Source: Wikipedia

Source: Jamtalhuette.at

- A total of **60 cryoconite holes** were sampled on the Jamtalferner (Galtur, Austria) from late June to early September on a regular basis.
- Sampling was consistently carried out in the ablation area, each time selecting 10 random cryoconites.
- **Flow-through** (R) and **isolated** cryoconites (L) were labelled accordingly.
- **No ski resorts** in the study area, only occasional hikers.

Interactive Index » *Background* ***Study Area*** *Results 1* *Results 2* *Results 3a* *Results 3b* *Discussion*

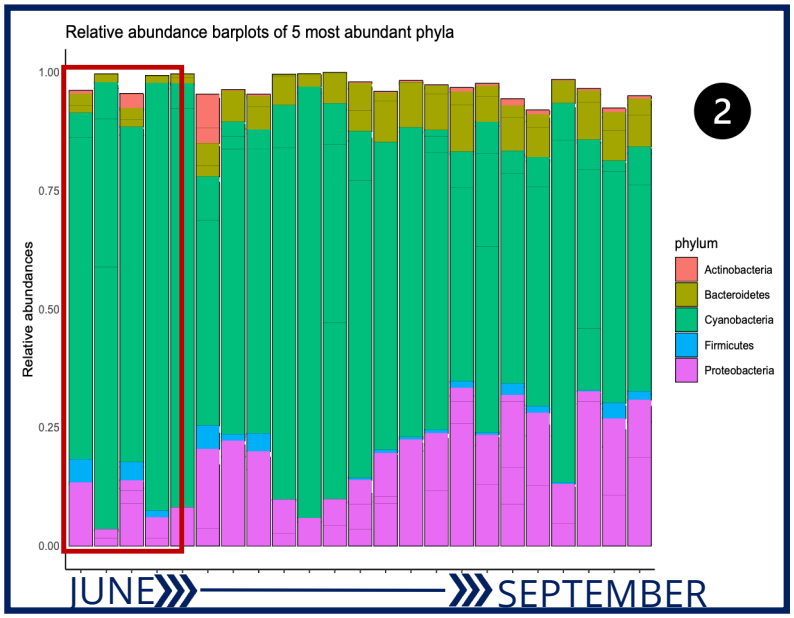
Intra-seasonal trends of cryoconite bacterial communities on an Alpine Glacier – Results 1

General summary	
Mean read length	*1 446.4*
Mean read quality	*13.5*
Median read length	*1 450*
Median read quality	*16.4*
Number of reads	*294 350*
Read length N50	*1 450*
STDEV read length	*85.3*
Total bases	*425 757 379*

1

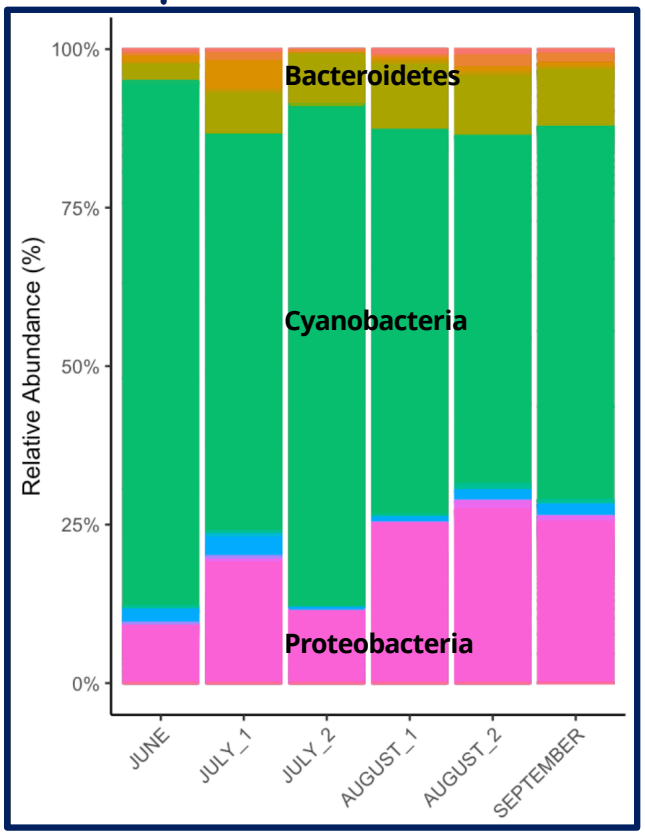
Sequencing Yield

Rarefaction



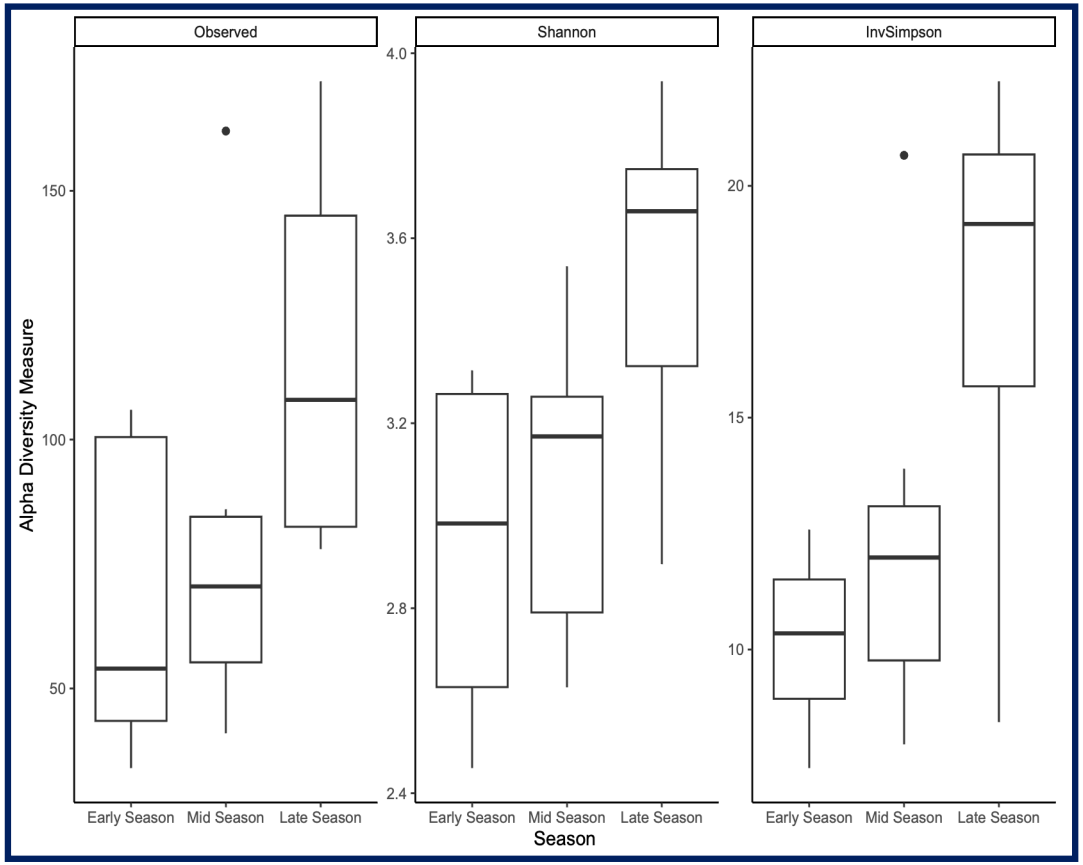
Aggregation

4 **Composition modeling**



Intra-seasonal trends of cryoconite bacterial communities on an Alpine Glacier – Results 2

Diversity increases consistently along the season.



Late June
Early July
EARLY SEASON

Late July
Early August
MID SEASON

Late August
Early September
LATE SEASON

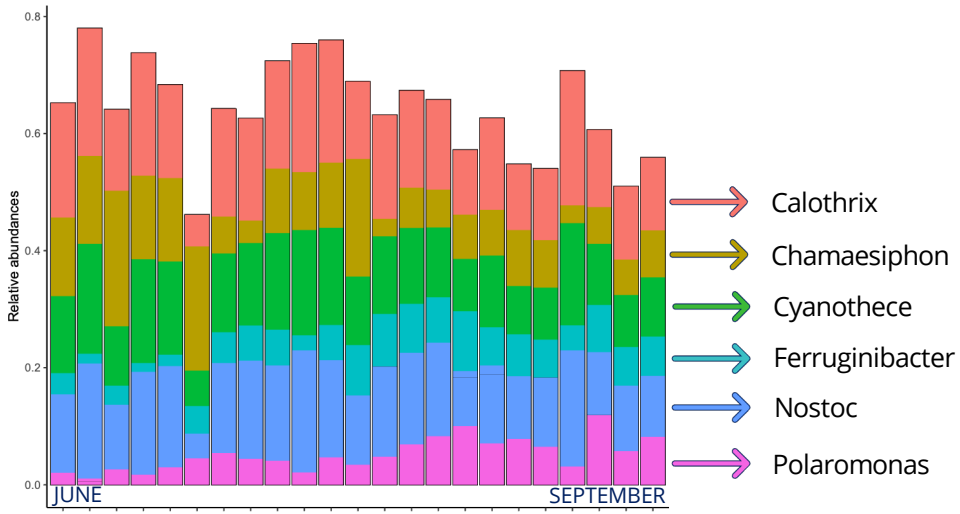
Intra-seasonal trends of cryoconite bacterial communities on an Alpine Glacier – Results 3a

Are the observed trends backed up by the models?

Composition

What did we model?

The composition (relative abundances) of the six most abundant genera across all *barcodes*, using the number of days since ablation onset as the predictor.



Method: generalized linear (mixed) models fit (glmmTMB, beta family)

Diversity

What did we model?

The values of the previously shown indexes (observed diversity, Shannon and Inverse Simpson) using the *number of days* since ablation onset as the predictor.

Due to the unbalance introduced in the design by the different number of cryoconites pooled into single barcodes, residual regression is presented for Observed and Shannon diversty.

How?

Fit the "beyond optimal" model that includes all the available predictors and their interaction terms, to avoid missing unexpected/masked effects on the response.

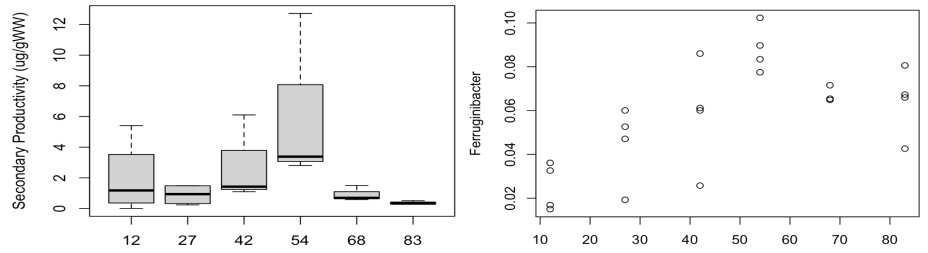
Progressively exclude non-significant/nuisance predictors, to obtain the simplest but most informative structure.

Intra-seasonal trends of cryoconite bacterial communities on an Alpine Glacier – Results 3b

Models' outputs

Composition

❑Calothrix: n.s. (z = -1.065; P = 0.287)
❑Chamaesiphon: **sign. decrease** (-3.290; 0.001**)
❑Cyanothece: n.s. (-1.621; 0.105)
❑Nostoc: n.s. (-0.706; 0.48)
❑Polaromonas: **sign. increase** (4.306; 1.66e-05***)
❑Ferruginibacter: **sign. increase** (quad. -3.270; 0.00108**)



Hints...?

Diversity

❑Observed div.: **sign. increase** (t_{20df} = 3.583; P= 0.00186**)
❑Inv. Simpson: **sign. increase** (t_{20df} = 4.705; 0.000136***)
❑Shannon: **sign. increase** (t_{20df} = 4.066; 0.000603***)

Note: observed diversity and Shannon positively correlate to the number of cryoconite holes pooled together during library preparation.

Secondary productivity does not show any significant effect when considered as predictor in the analyses.

The type of cryoconite does suggest any specific difference in community composition or overall diversity

Food for Thoughts

Climate change is deeply affecting the cryosphere and its associated habitats.

How far can we extend the parallelism with "traditional" ecosystems?

What are we losing along with the ice?

Complex microbial communities that follow fully fledged ecological successions.

Relevant for...

Diversity loss

Functional loss

Plastic degraders

Pesticide degraders

Antibiotic resistances

Other potential biotech interests