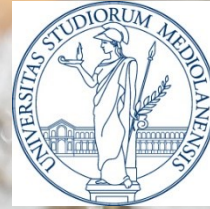




Università degli Studi
di Milano - Bicocca



Università degli Studi
di Milano

Ecologia dei ghiacciai



Roberto Ambrosini
Dipartimento di Scienze e Politiche Ambientali
Università degli Studi di Milano, Milano – ITALIA

Ghiacciai e calotte polari come bioma

Opinion

Trends in Ecology and Evolution, [April 2012](#)

Cell
PRESS

Glaciers and ice sheets as a biome

Alexandre M. Anesio and Johanna Laybourn-Parry

Bristol Glaciology Centre, School of Geographical Sciences, University of Bristol, UK, BS8 1SS

Ecological Monographs, 78(1), 2008, pp. 41–67

© 2008 by the Ecological Society of America

GLACIAL ECOSYSTEMS

ANDY HODSON,^{1,9} ALEXANDRE M. ANESIO,² MARTYN TRANTER,³ ANDREW FOUNTAIN,⁴ MARK OSBORN,⁵
JOHN PRISCU,⁶ JOHANNA LAYBOURN-PARRY,⁷ AND BIRGIT SATTLER⁸

Coppette crioconitiche



Studi multidisiplinari

Glaciologia
Ecologia
Microbiologia
Zoologia

28

29

20



BioMolecular Tools

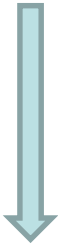
Estrazione
del DNA



MiSeq™

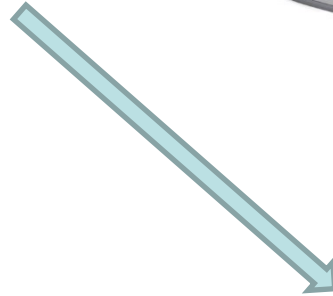
16S rRNA
Amplicon
Sequencing

Chi?



qPCR

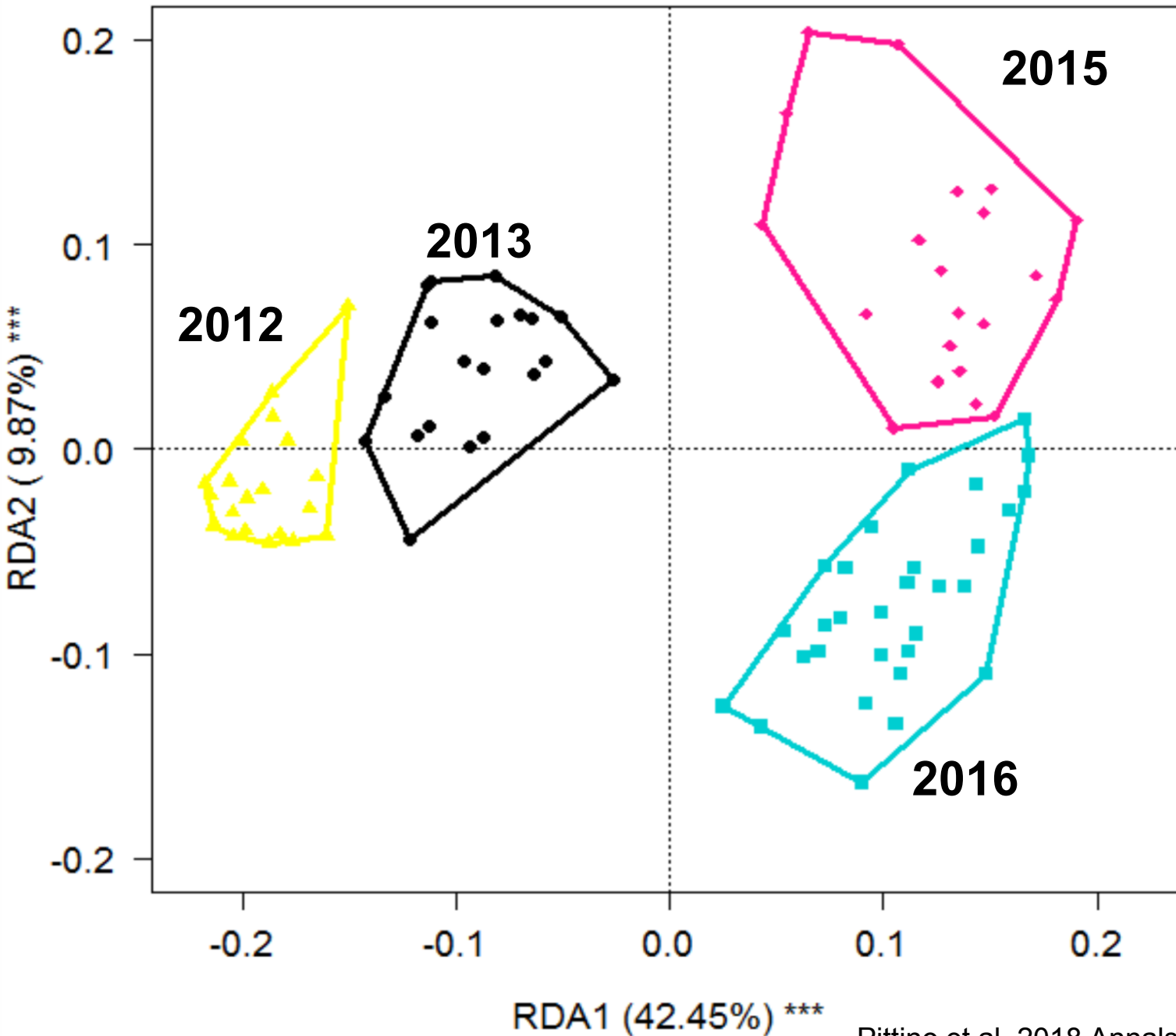
Quanti?



HiSeq 2000™

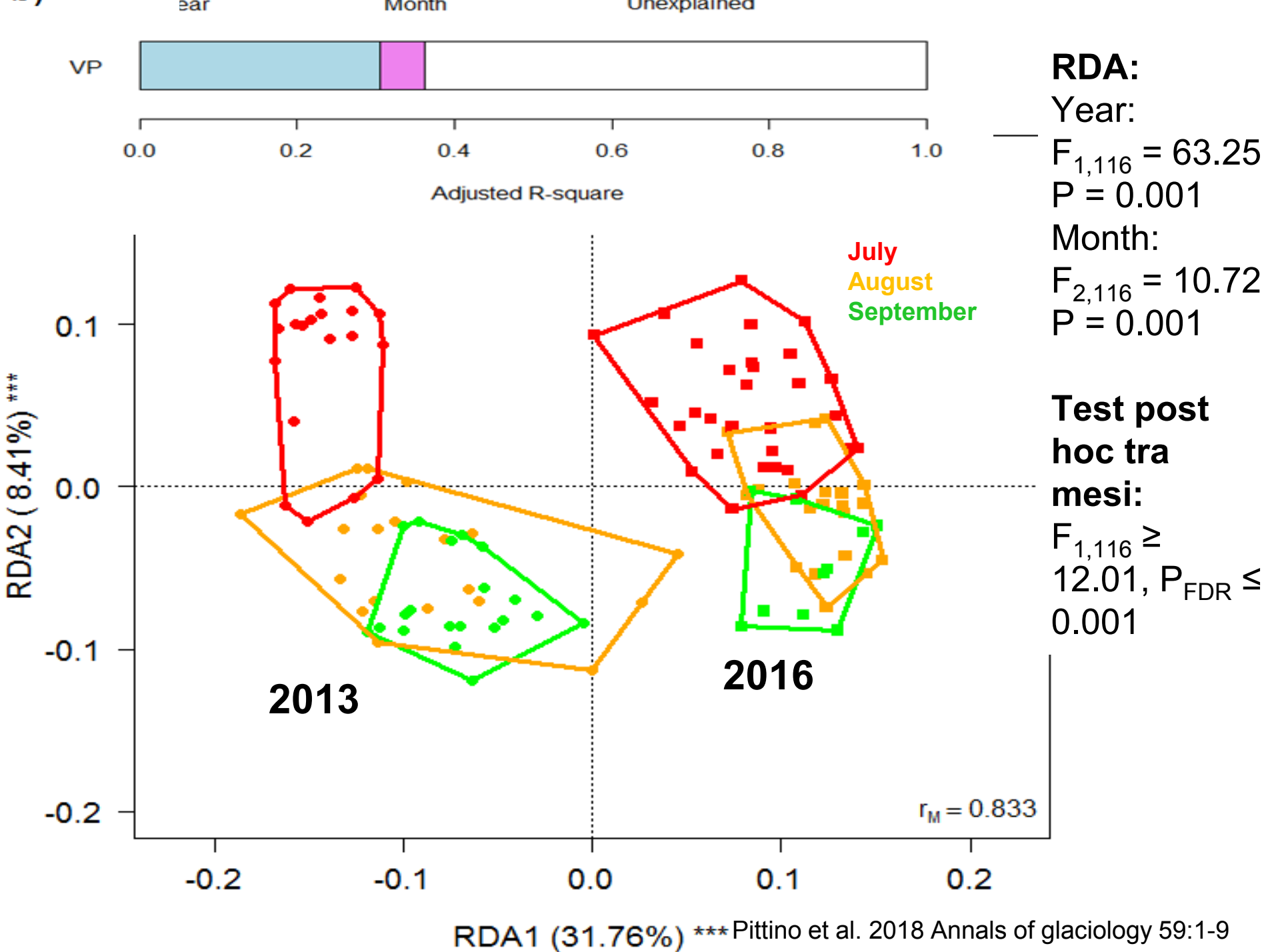
Whole Metagenomic
sequencing

Cosa?



RDA:
 $F_{3,88} = 34.34$,
 $P = 0.001$,
 $\text{Adj-R}^2 = 0.524$

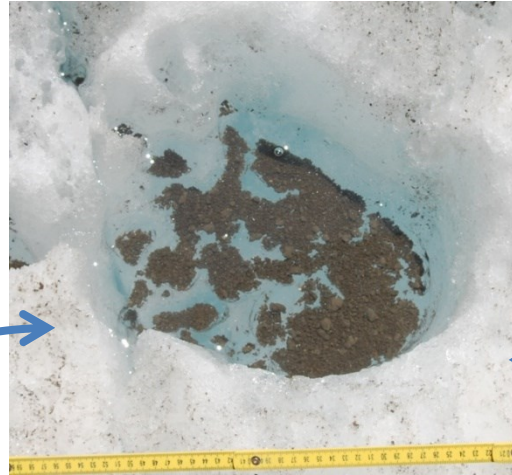
Test post hoc
 $F_{1,49} \geq 15.1$
 $P_{\text{FDR}} \leq 0.002$



Modello concettuale



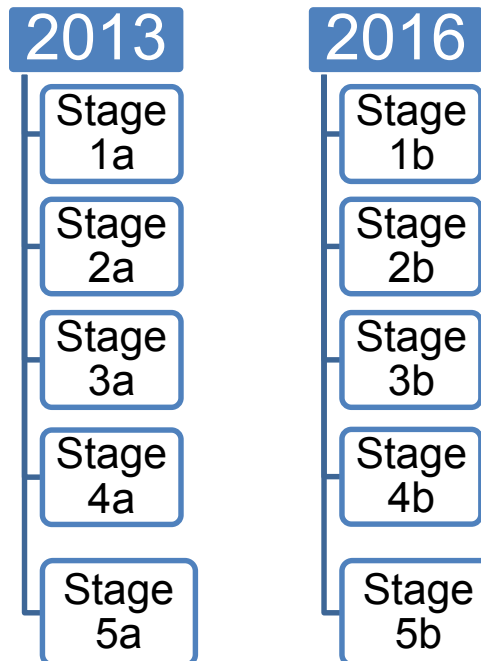
Comunità iniziale nel 2013 (a)



Comunità iniziale nel 2016 (b)

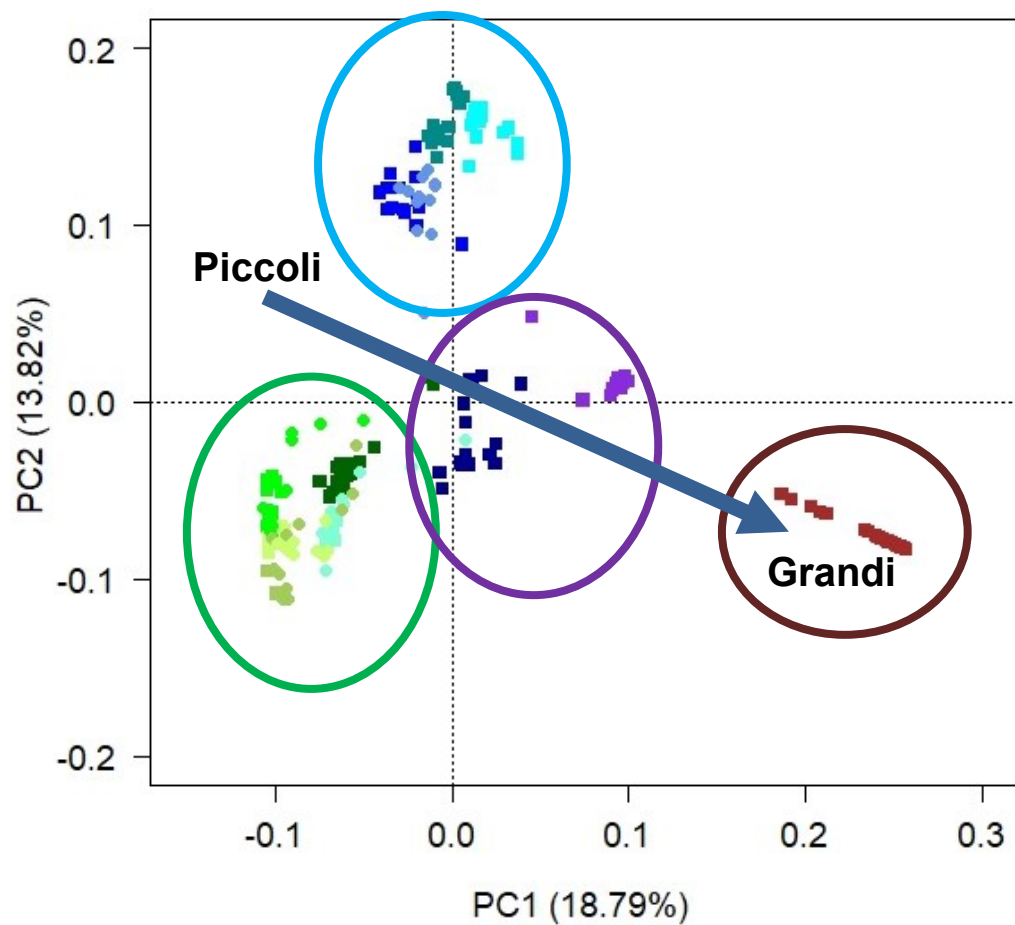


Diversi input batterici dal manto nevoso o dagli ambienti circostanti



Trend stagionali "paralleli"

Variabilità geografica

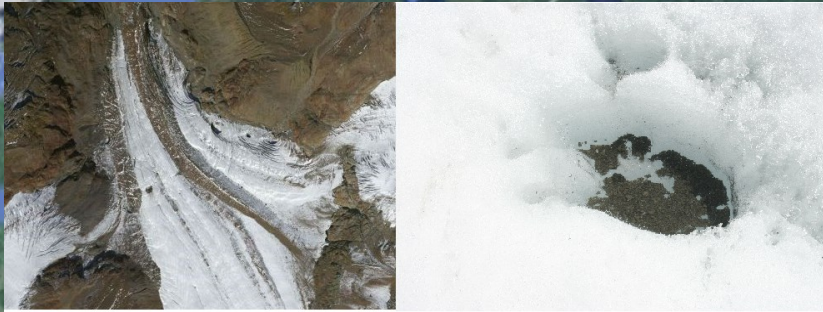


- Baltoro
- Forni
- Gran Zebrù Est
- Zebrù Est
- Cedec
- Gran Zebrù
- Iver
- Iver Est
- Morado
- Morado Nord
- Exploradores
- Perito Moreno



Shotgun metagenome

- 60 campioni raccolti tra luglio e settembre 2013



● Ghiacciaio dei Forni

● Baltoro Glacier

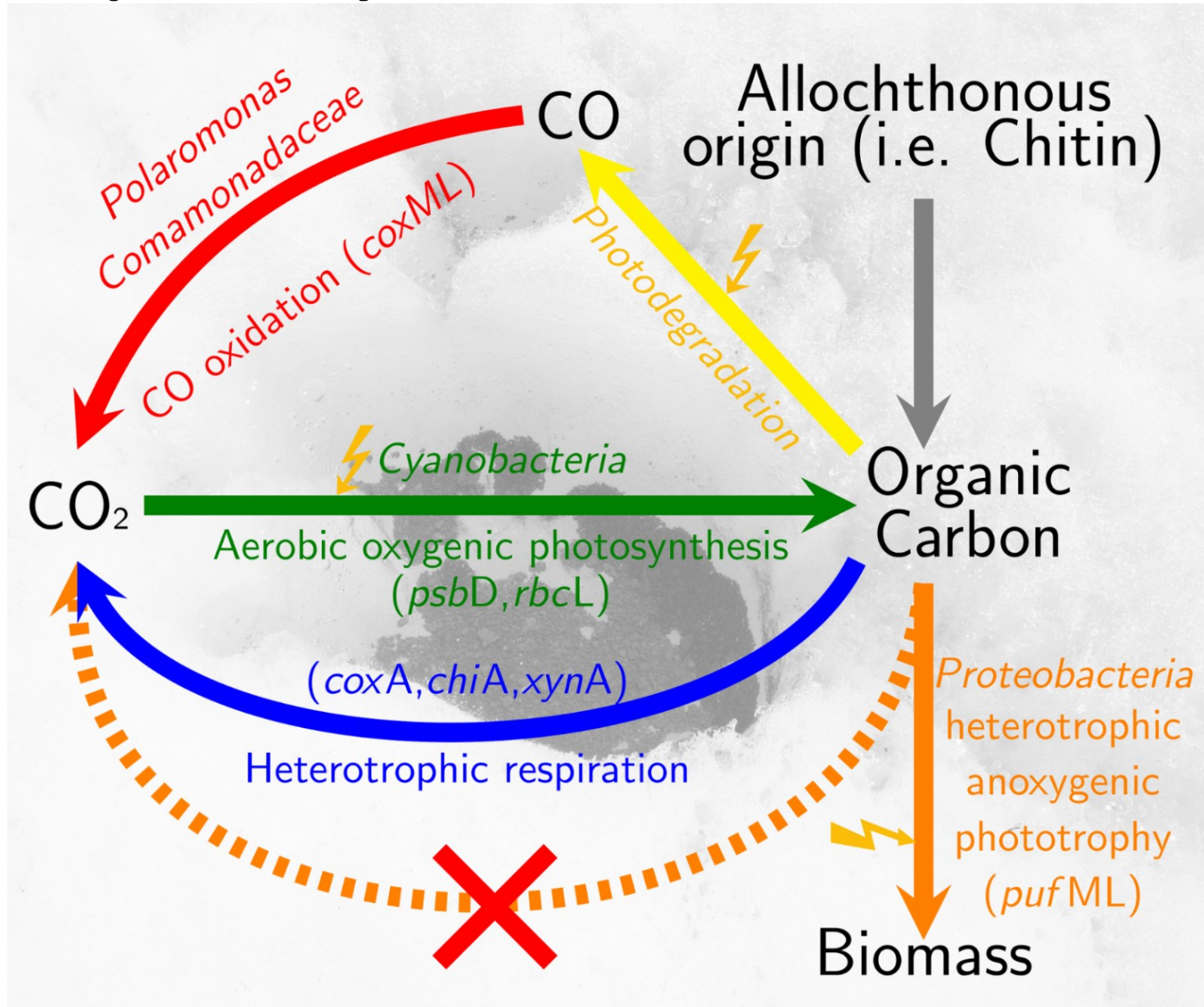
- 30 campioni raccolti a luglio 2013



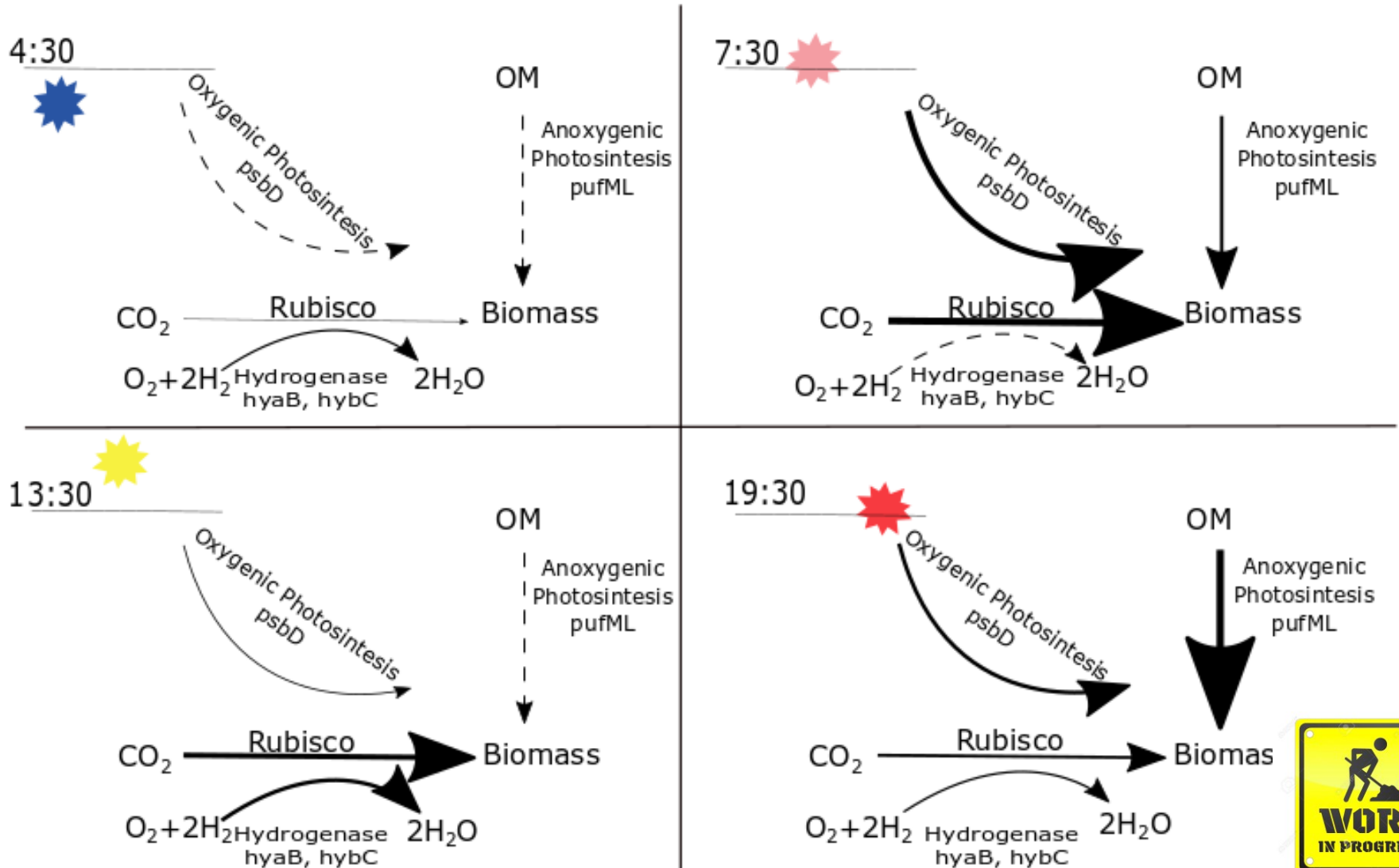
Funzioni ecosistemiche delle coppette crioconitiche

Metabolisms	Pathway	Marker Genes	Short name
Photosynthesis	Oxygenic photosynthesis	photosystem II P680 reaction center D2 protein	psbD
	Aerobic anoxygenic photosynthesis	photosynthetic reaction center L and M subunits	pufLM
Autotrophy	CO ₂ fixation, Calvin-Benson cycle	ribulose biphosphate carboxylase small and large chain (RubisCO)	rbcSL
Chemolitotrophy	Sulfur oxidation	sulfur-oxidizing proteins SoxAC	soxAC
	Carbon monoxide oxidation	carbon-monoxide dehydrogenase medium and large subunits	coxML
Natural polymer degradation	Chitin assimilation	chitinase	chiA
	Hydrolysis O- and S-glycosyl compounds	endo-1,4-beta-xylanase	xynA
Terminal electron accepting processes	Aerobic respiration	cytochrome c oxidase subunit I	coxA
	Dissimilatory nitrate reduction (Denitrification)	nitrate reductase alpha subunit, nitrite reductase	narG, nirK

Proposed cryoconite carbon “interactome”

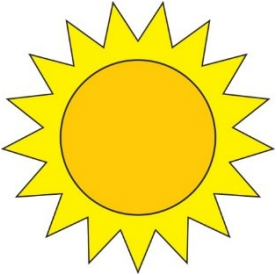


Metatranscrittomica

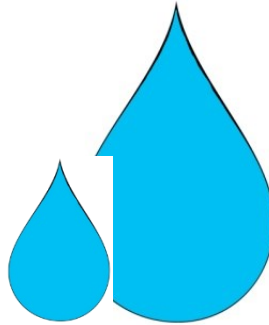




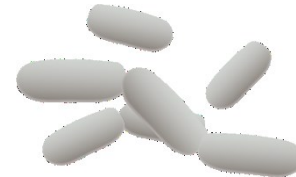
Vie di degradazione



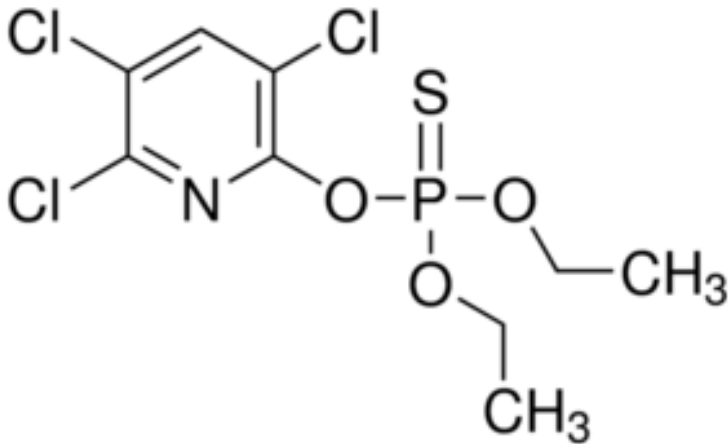
Fotodegradazione



Idrolisi



Biodegradazione



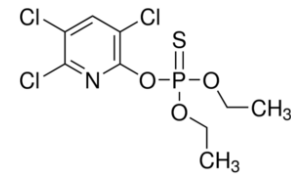
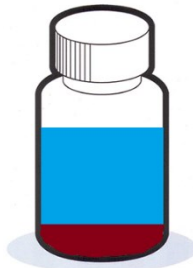
CHLORPYRIFOS (CPF)

- CPF un pesticida usato in agricoltura
- CPF può essere trasportato in atmosfera per 62-430 km dal sito di applicazione
- CPF è stato trovato sul ghiacciaio dei Forni

Microcosmi

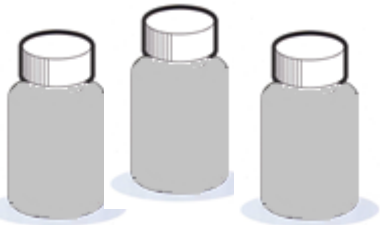


**crioconite
+
Acqua di
fusione**

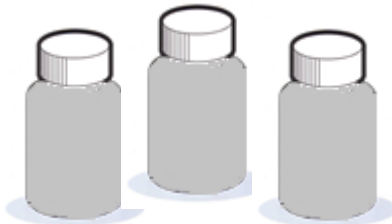


**Inoculo di
CPF (0.2
µg/mL)**

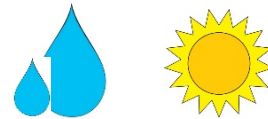
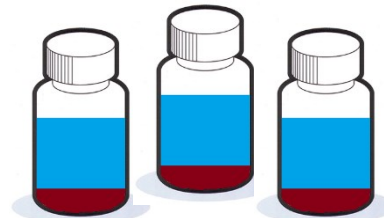
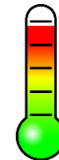
**Dark -
sterile**



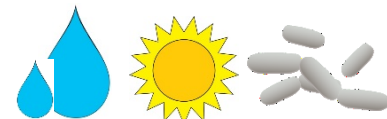
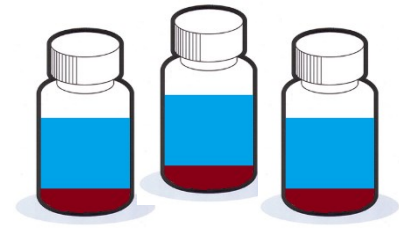
**Dark -
bacteria**



**Light -
sterile**



**Light -
bacteria**



Esperimento in situ



CPF quantification



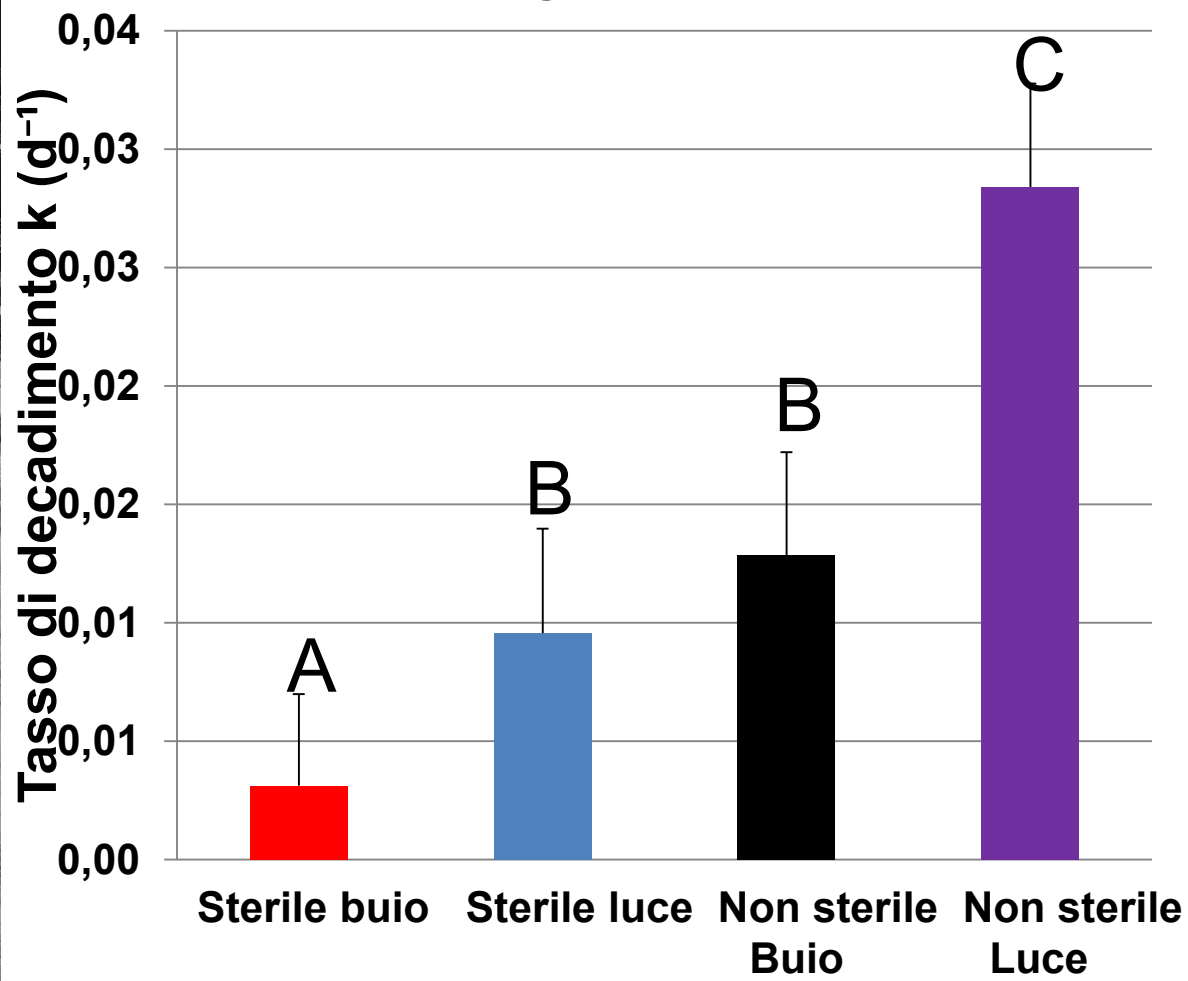
MiSeq™

16S rRNA gene amplicon sequencing



16S rRNA qPCR quantification

Tasso di degradazione del CPF



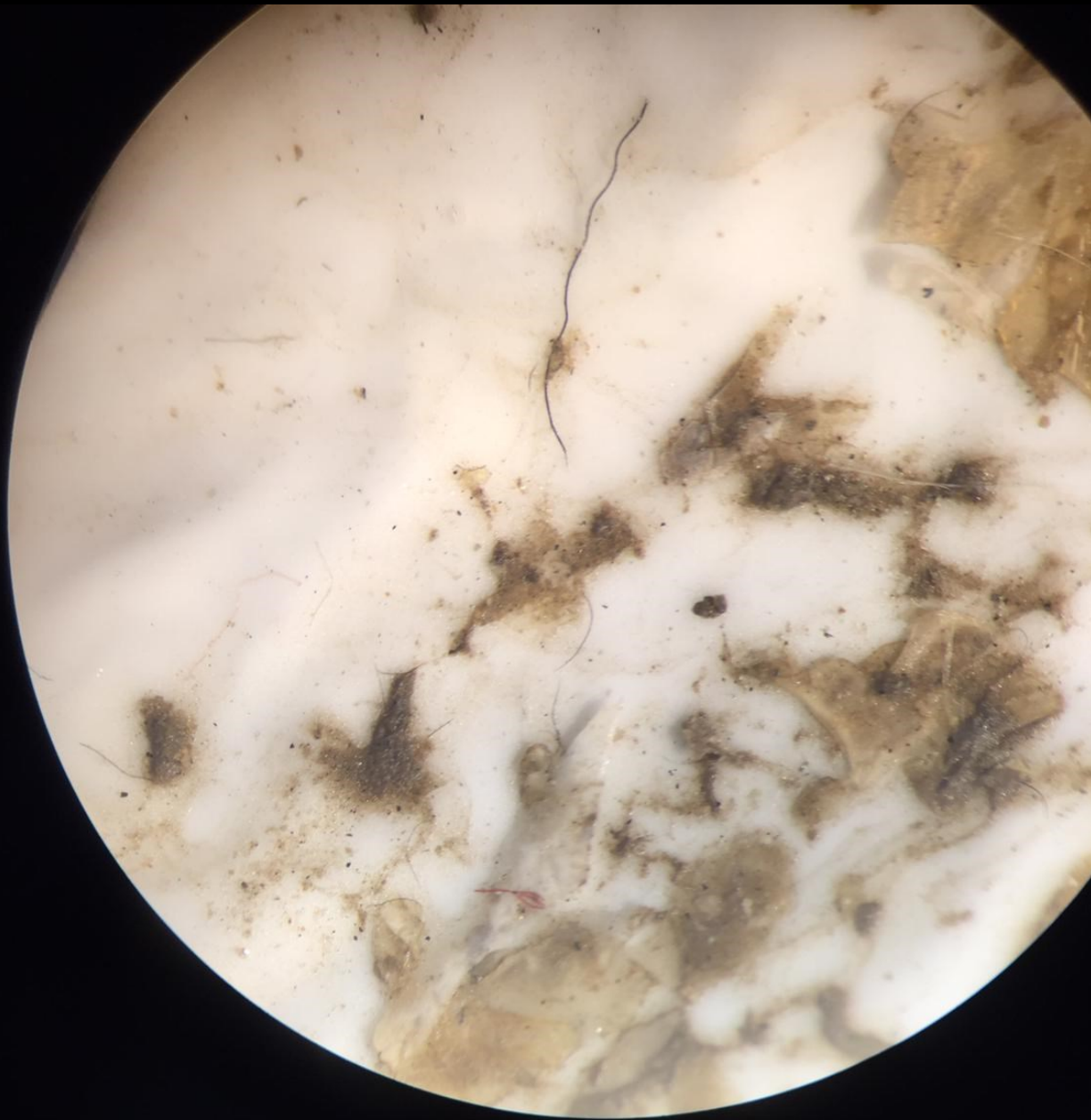


74 particelle di microplastica per kg di sedimento.

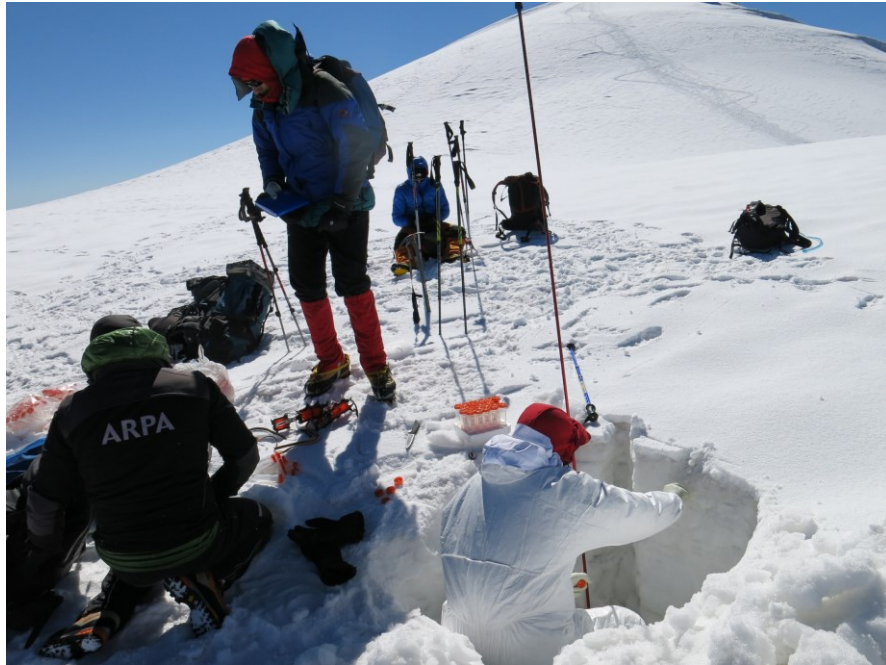


UNIVERS





Altre linee di ricerca



Batteri della neve

Tardigradi



Krzysztof
Zawierucha
[Adam Mickiewicz
University](#)



Water bears dominated cryoconite hole ecosystem densities, habitat preferences and physiological characteristics of Tardigrada on an alpine glacier

Temporal variability of bacterial communities in cryoconite on an alpine glacier

Krzysztof Zawierucha · Jakub Buda · Roberto Sergio Azzoni · Malgorza

12 articoli su riviste ISI

2 ISME Journal (IF 9.3)
2 Environmental Pollution (IF 5.7)
2 Annals of Glaciology (IF 2.3)

110 citazioni

Bacteri
glacie

¹“A. Desio” Department of Earth Sciences, University of Milano, Milano, Italy, ²Department of Earth and Environmental Sciences (DISAT), University of Milano-Bicocca, Milano, Italy, ³National Research Council, Institute of Ecosystem Study (ISE-CNR), Verbania Pallanza, Italy, and ⁴Department of Biotechnology and Biosciences, University of Milano-Bicocca, Milano, Italy

Francesca PITT
Roberto S
Robei
Roberto Ambrosini¹ · Federica Musitelli¹ · Federico Navarra¹ · Ilario Tagliaferri¹ · Isabella Gandolfi¹ · Giuseppina Bestetti¹ · Christoph Mayer² · Umberto Minora³ · Roberto Sergio Azzoni³ · Guglielmina Diolaiuti³ · Claudio Smiraglia³ · Andrea Franzetti¹



Grazie per l'attenzione



Dipartimento di Scienze
dell' Ambiente e della
Terra

Laboratory of Environmental Microbiology

email: andrea.franzetti@unimib.it

www.disatmicrobiology.it

 @microDISAT



Dipartimento di Scienze
e Politiche Ambientali

Quantitative Ecology Group

email: robeto.ambrosini@unimi.it