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LIÈGE université

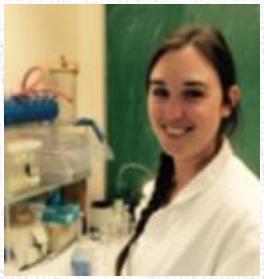
CIP CENTRE FOR PROTEIN ENGINEERING

GREAT AT SMALL THINGS

Conservation and characterization of Polar Cyanobacteria by the BCCM/ULC collection

Anne-Catherine Ahn[1], Kim Beets[1], Benoit Durieu[2], Véronique Simons[3], Annick Wilmotte[1,2]

1. BCCM/ULC culture collection of cyanobacteria, University of Liège, Liège, Belgium
2. InBios-Centre for Protein Engineering, University of Liège, Liège, Belgium
3. BCCM/MUCL, Université catholique de Louvain, Louvain-la-Neuve, Belgium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1) History and objectives of BCCM/ULC

2) Biodiversity, genomics and exploration of the bioactivity potential

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GREAT AT SMALL THINGS

Since 2006

From in-house research collection

To public collection

research-based

providing services

open for legitimate users

operating within a legal framework

linked to the Belgian Coordinated Cultures of Microorganisms (BCCM)

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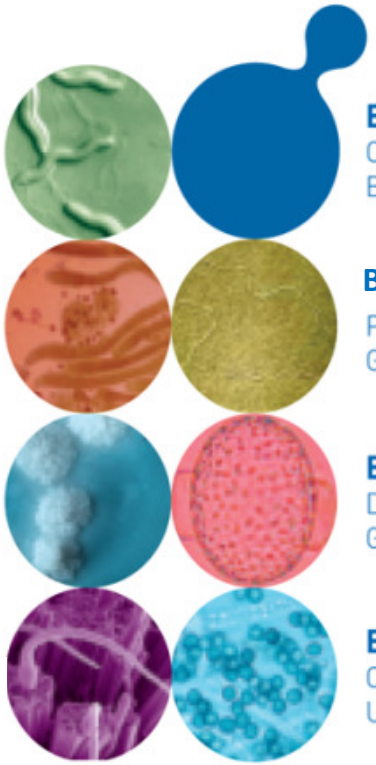
The BCCM Consortium

7 decentralised culture collections, coordinated by a Central team at the Belgian Science Policy Office.



BCCM/LMG
Bacteria
Ghent University

BCCM/CC
Coordination Cell
Belgian Science Policy Office

BCCM/IHEM
Fungi Collection: Human & Animal Health,Sciensano, Brussels

BCCM/GeneCorner
Plasmids
Ghent University

BCCM/ITM
Mycobacteria
Institute of Tropical Medicine, Antwerp

BCCM/DCG
Diatoms
Ghent University

BCCM/MUCL
Agro-food & Environmental Fungi
Université catholique de Louvain

BCCM/ULC
Cyanobacteria
University of Liège

ISO 9001 CERTIFIED VINÇOTTE

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Culture collections are important because

« we publish and then, we move labs, we change jobs, …..
or …. we perish »

Therefore, **important biological material and related information might be lost forever**.

Hi Annick,
Unfortunately I don't have them either in the move to _h about
five years ago I think they did not move over.
Sorry about that...

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BCCM GREAT AT SMALL THINGS
BELGIAN CO-ORDINATED COLLECTIONS OF MICRO-ORGANISMS

BCCM/ULC public collection of cyanobacteria

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-246 unicyanobacterial strains, of which 120 of polar origin

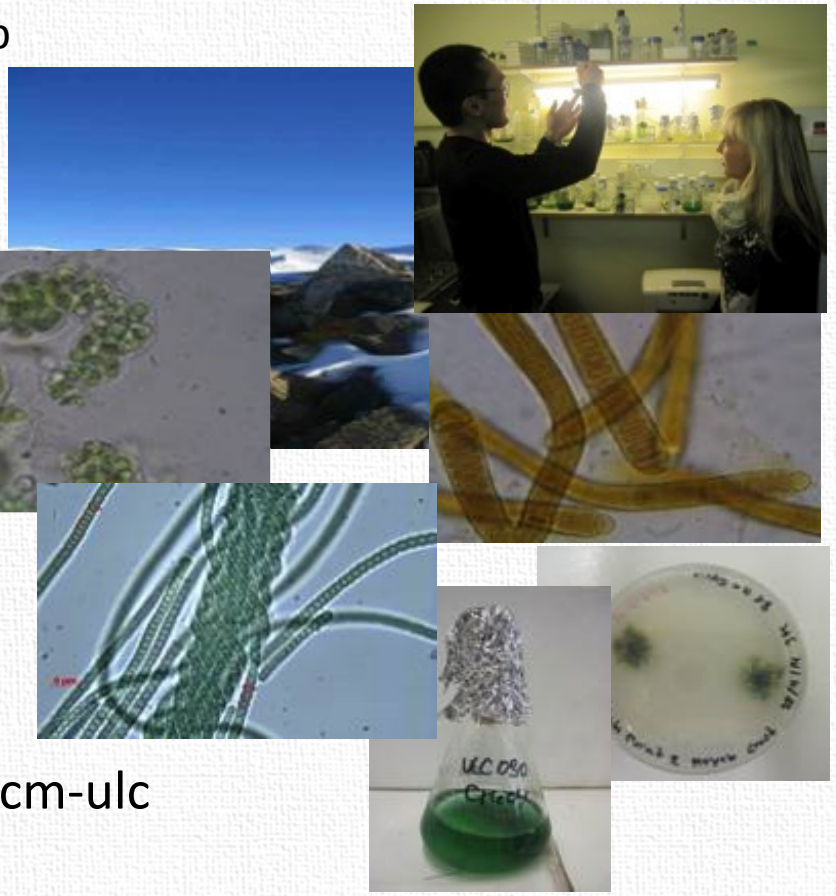
-Maintenance as living cultures, with a cryopreserved back-up

-ISO 9001 certificate for deposit and distribution services

-New: possibility of safe deposit!

-Geographic focus on cyanobacteria from the Polar Regions

-Taxonomic focus to obtain representatives of most abundant orders (Chroococcales, Chroococcidiopsidales, Nostocales, Oscillatoriales, Pleurocapsales, and Synechococcales)



Website: https://bccm.belspo.be/about-us/bccm-ulc

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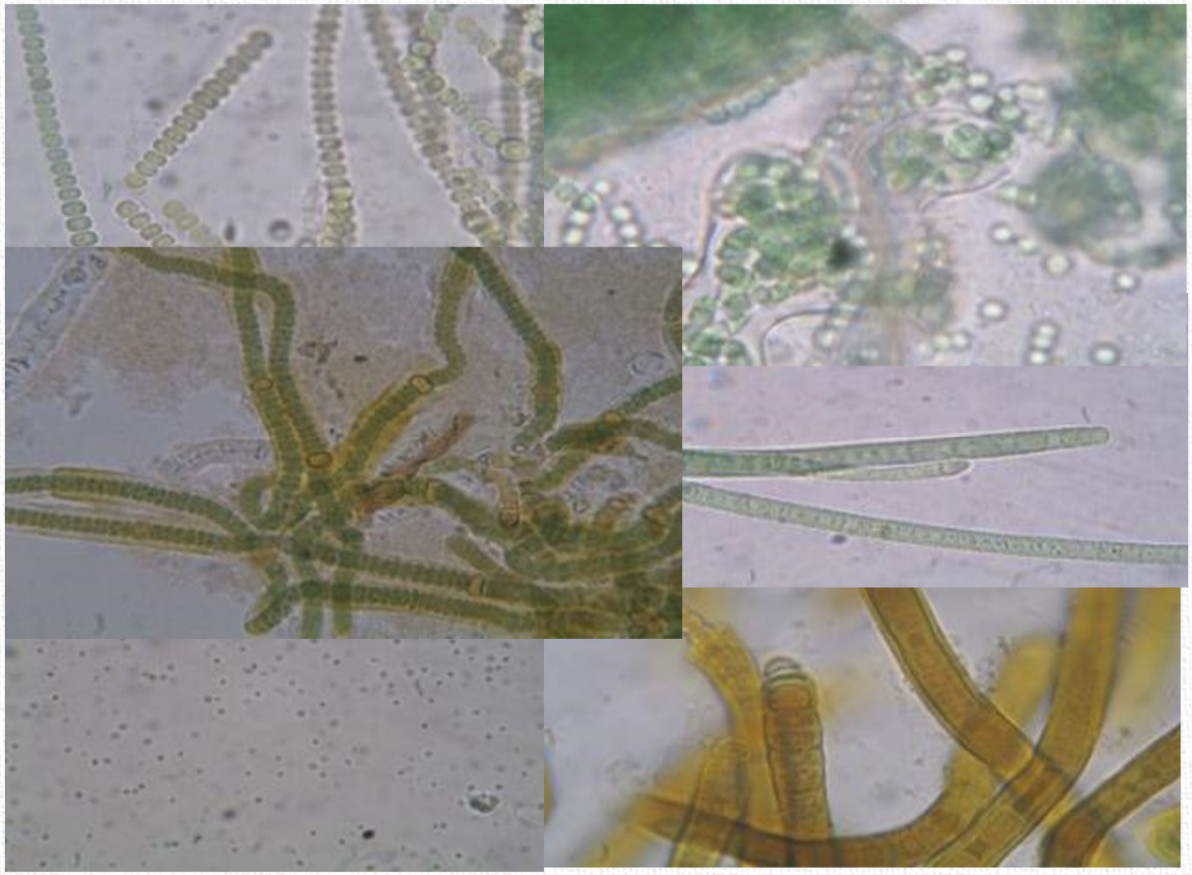
Quality Control of purity and authenticity:

microscopic observation, molecular markers (16S rRNA, ITS sequences)



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History and objectives

Biodiversity, genomics and exploration of the bioactivity potential

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Large diversity in the BCCM/ULC collection

16S rRNA gene of 206 ULC strains : **82 OTUs** (99% similarity treshold), of which **45 are of Polar origin**

Maximum Likelihood tree with Kimura 2-parameter and G+I model, 500 bootstraps, built with 992 positions of the 16S rRNA gene sequence

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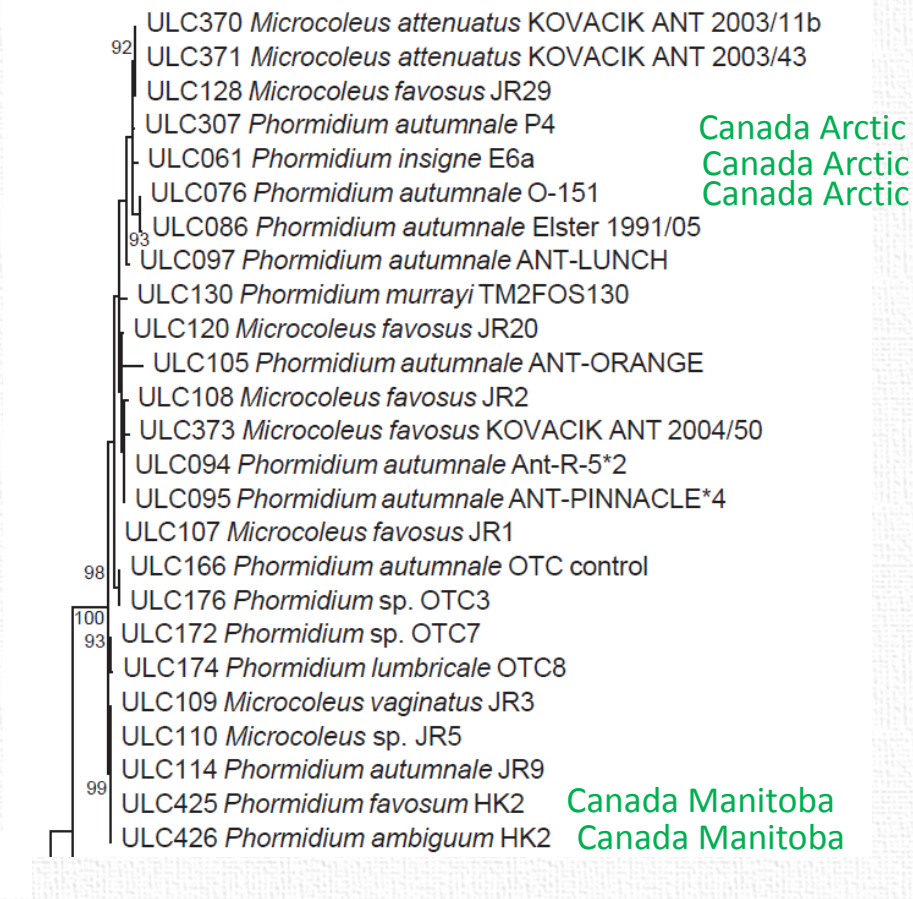
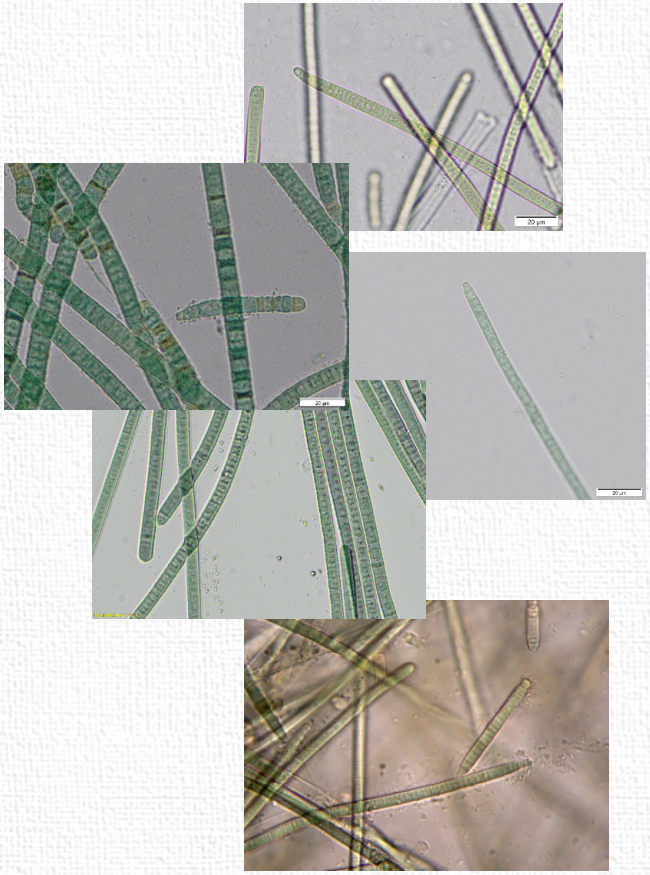
5 'Microcoleus' strains of Arctic/Canadian origin and 20 Antarctic strains (McMurdo Ice Shelf, James Ross Island, Antarctic Peninsula, SØr Rondane Mts, Transantarctic Mts





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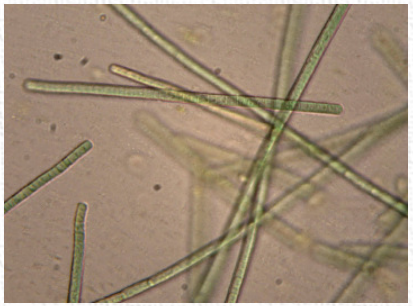
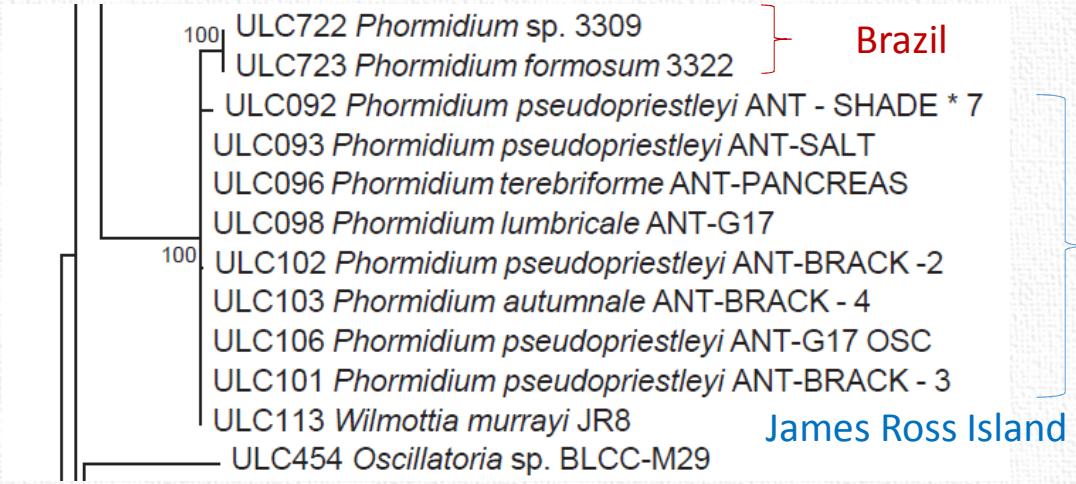
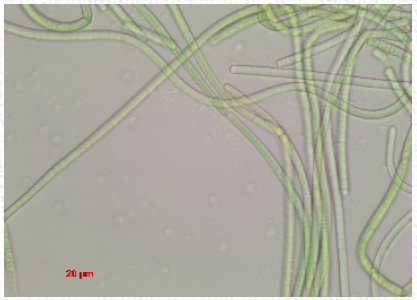
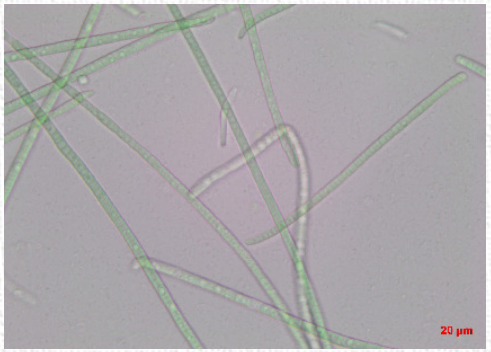
9 Antarctic 'Phormidium autumnale' strains





McMurdo Ice Shelf





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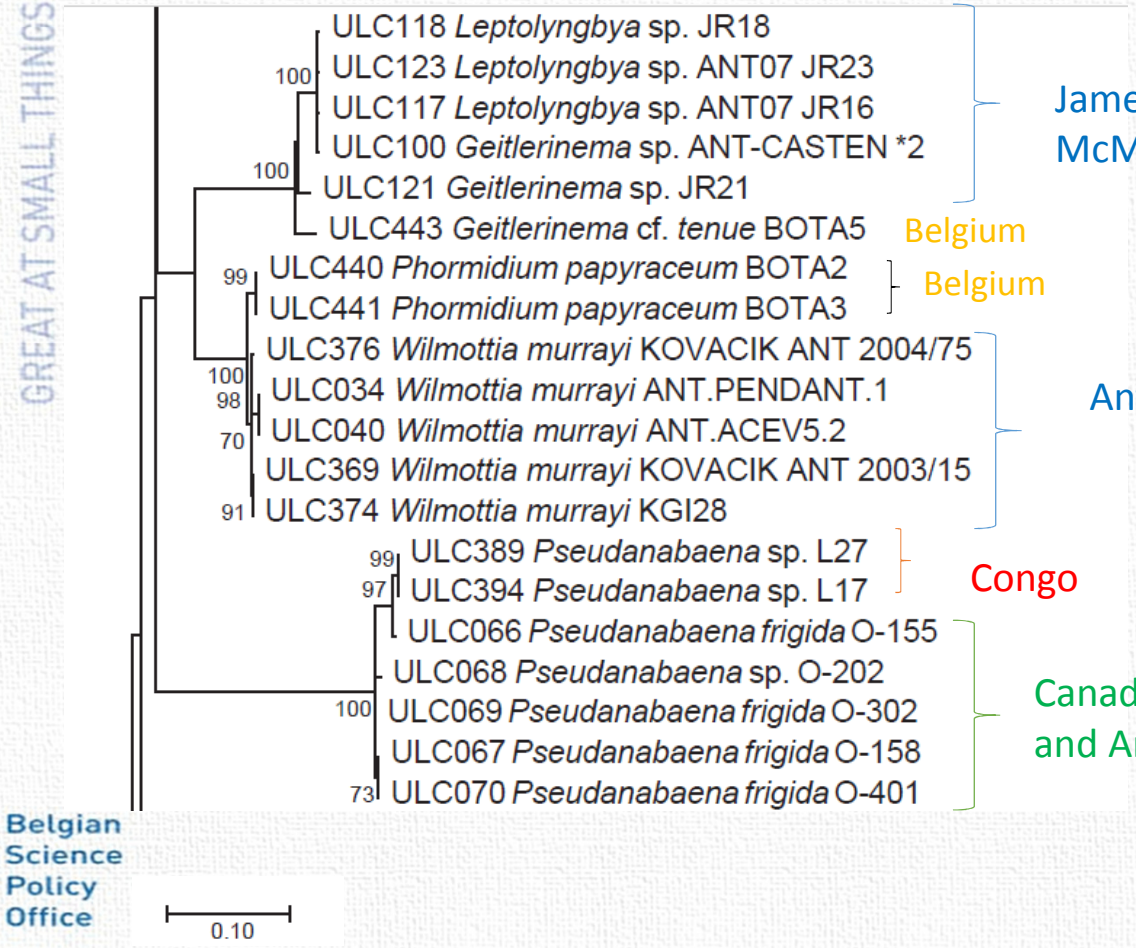
Filamentous genera: 10 Antarctic and 5 Canadian (2 Arctic) strains



James Ross Island and McMurdo Ice Shelf

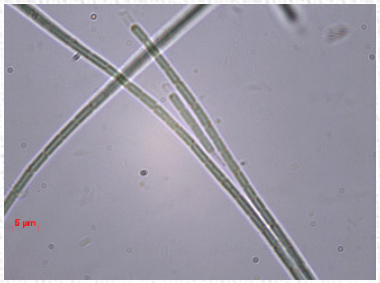
Belgium

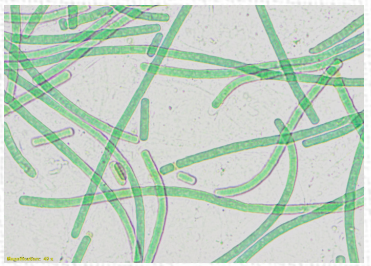
Belgium

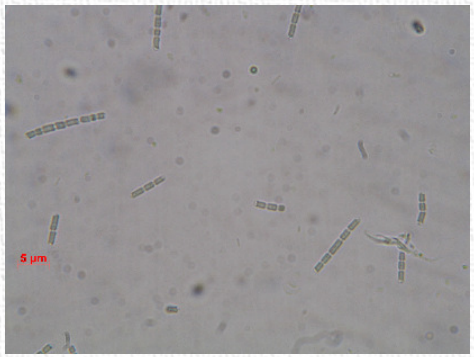
Antarctic Peninsula and Pridz Bay

Congo

Canada: Quebec and Arctic







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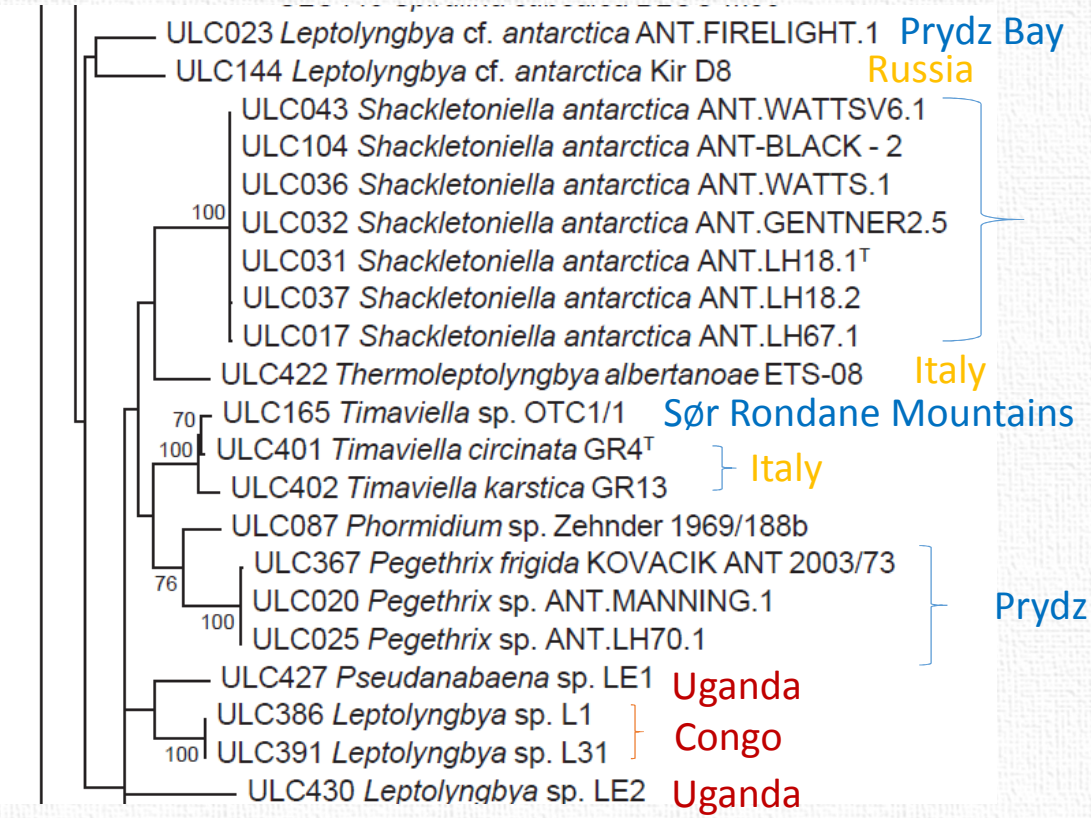
Filamentous genera: 12 Antarctic strains



Prydz Bay

Russia

Prydz Bay

Italy

Sør Rondane Mountains

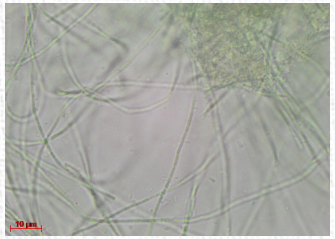
Italy

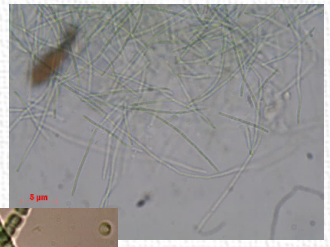
Prydz Bay and Antarctic Pensinsula

Uganda

Congo

Uganda





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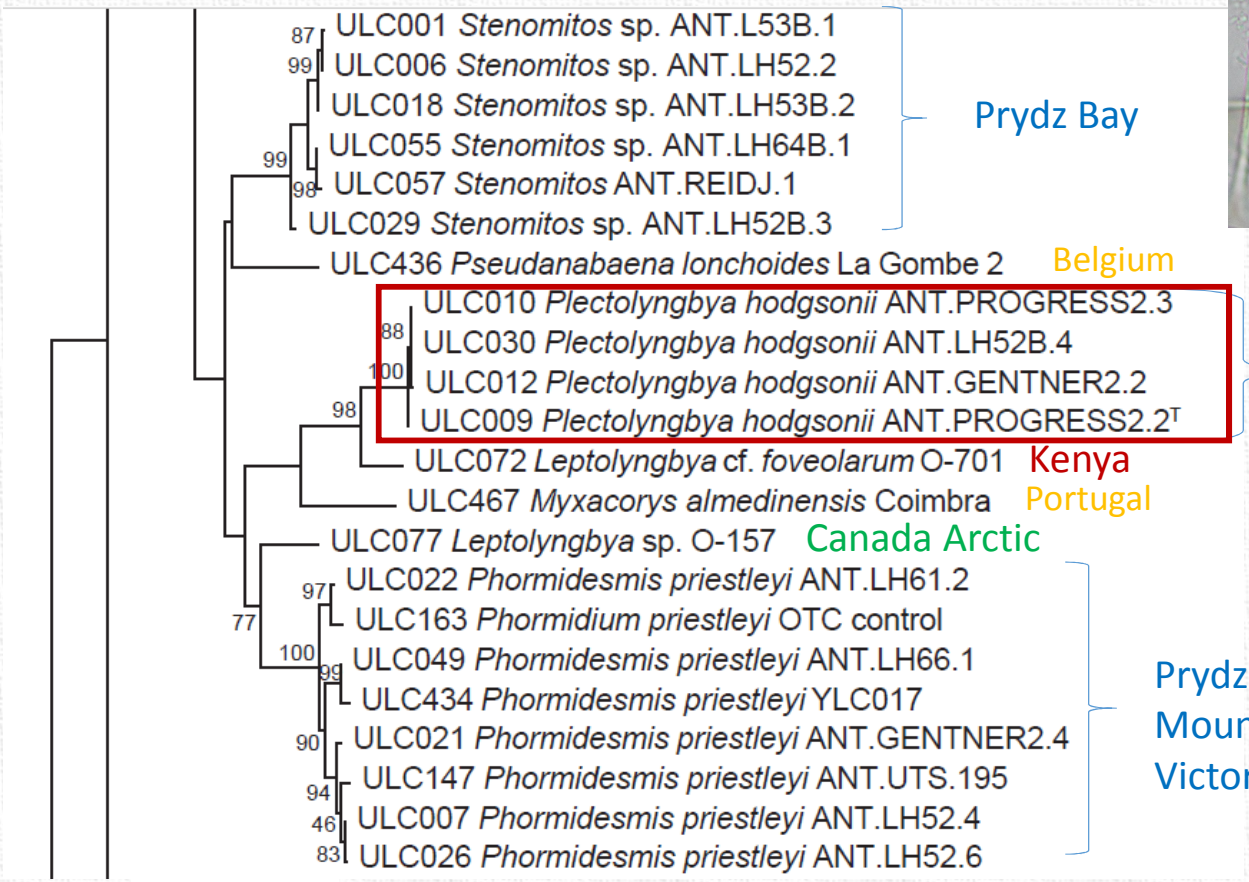
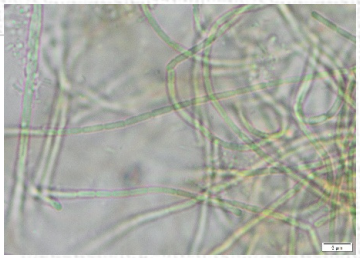
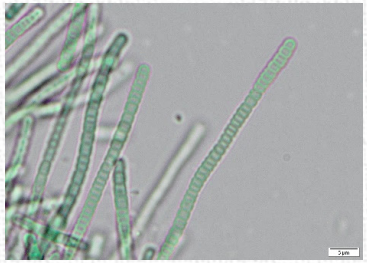
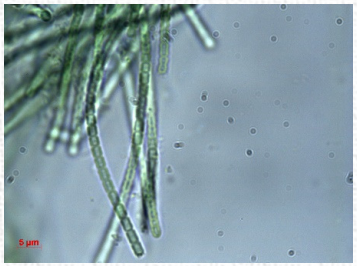
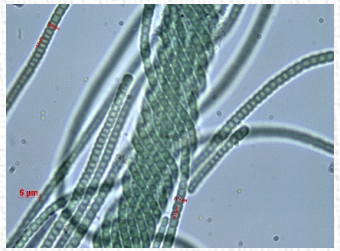
Filamentous genera: 18 Antarctic and 1 Arctic strain











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Polar Biol (2011) 34:181–191
DOI 10.1007/s00300-010-0868-y

ORIGINAL PAPER

Plectolyngbya hodgsonii: a novel filamentous cyanobacterium from Antarctic lakes

A. Taton · A. Wilmotte · J. Šmarda · J. Elster · J. Komárek

Potentially endemic genus, only found in Antarctica (Pridz Bay and Mc Murdo Dry Valleys)

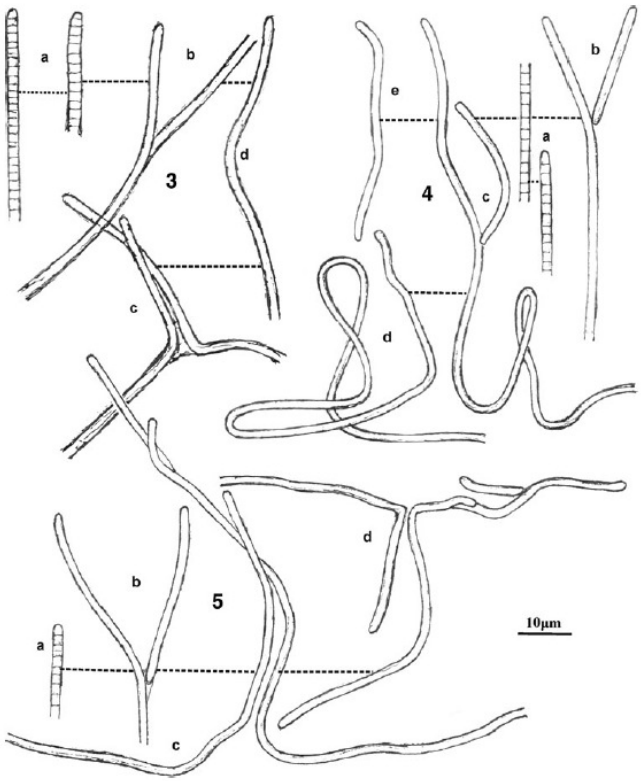

Fig. 3–5 *Plectolyngbya hodgsonii*: 3 = drawing of type material from the strain ANT.LPR3 (a detail of trichomes; b–c false branching of filaments; d simple filament); 4–5 = two different populations from Monolith Lake, James Ross Island (a detail of trichomes; b–d filaments, mostly with false branching; e germinating hormogonium). (Orig.)

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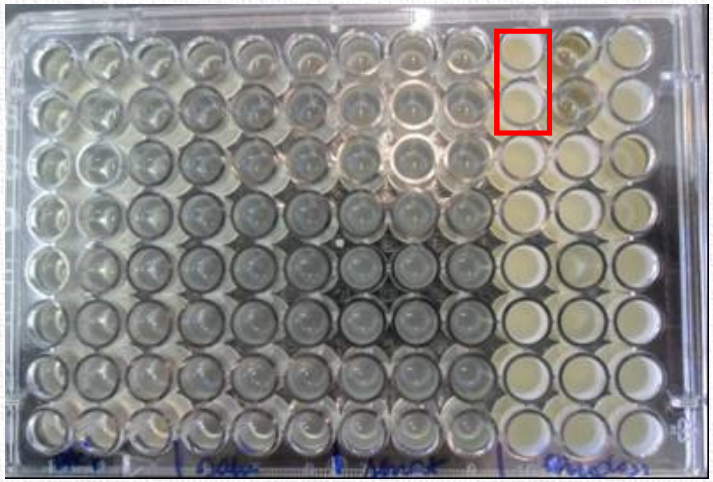
Bioassay of ULC009 against *Candida kruzeii*

200 µl of the diluted fungal cultures plus 20 µl of extracts in multiwell plate



Growth inhibition of *Candida kruzeii* by the secondary metabolites in the purified extract from ULC009 (right upper corner).

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Bilaterial cooperation (FNRS/CNPq) with Estella Stenico and Marli de Fatima Fiore (CENA, Piracicaba)

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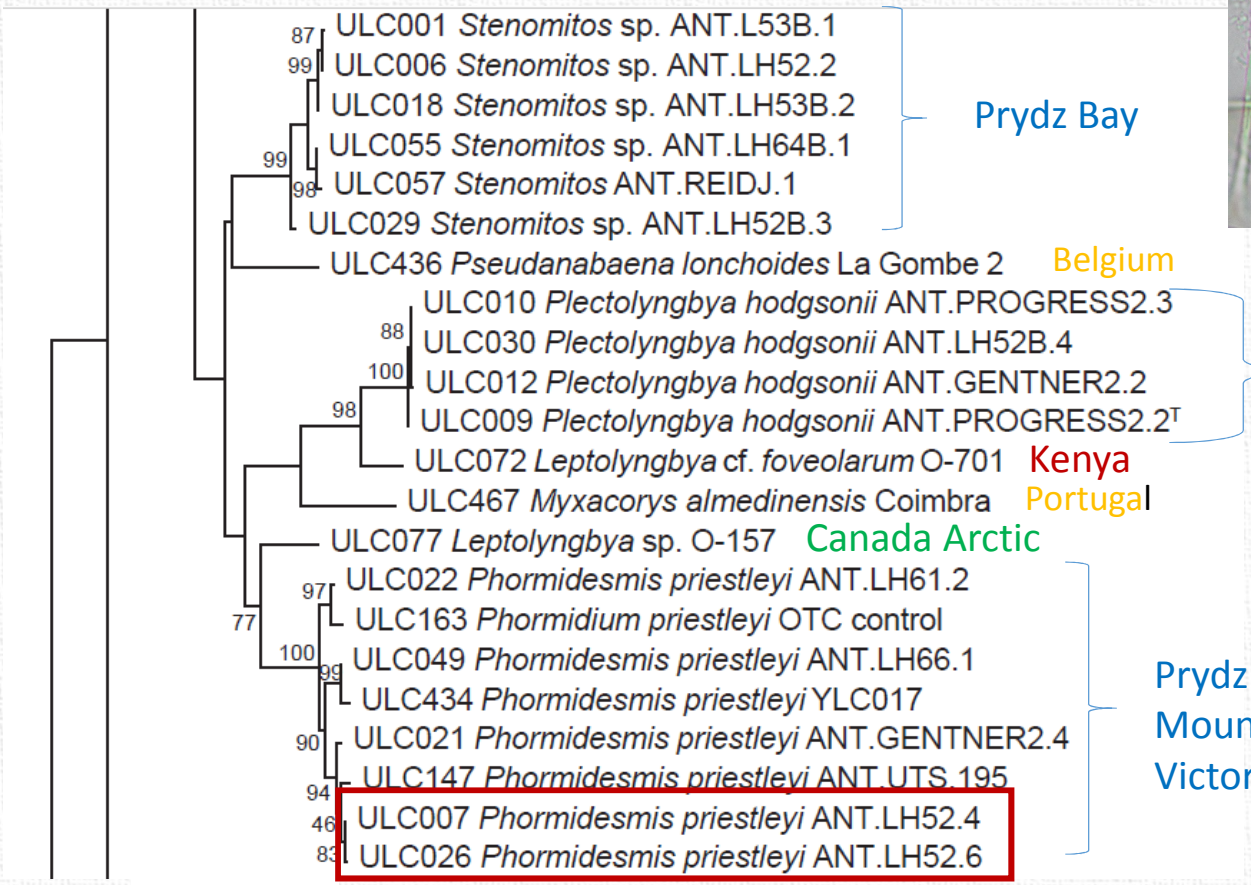
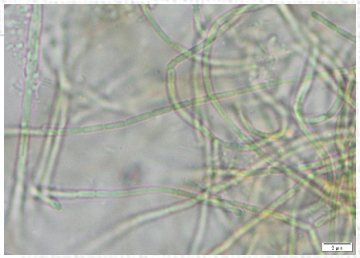
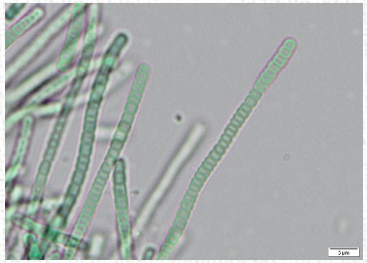
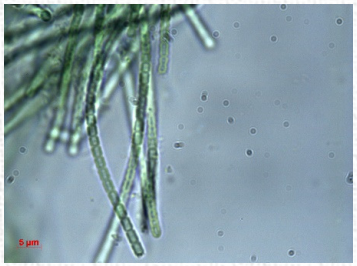
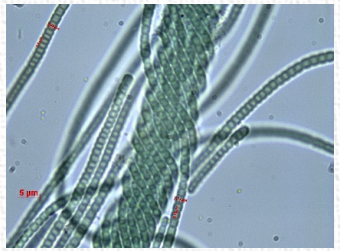
Filamentous genera: 18 Antarctic and 1 Arctic strains











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Phormidesmis priestleyi BCCM/ULC007*:* first genome sequence of Antarctic cyanobacterial strain

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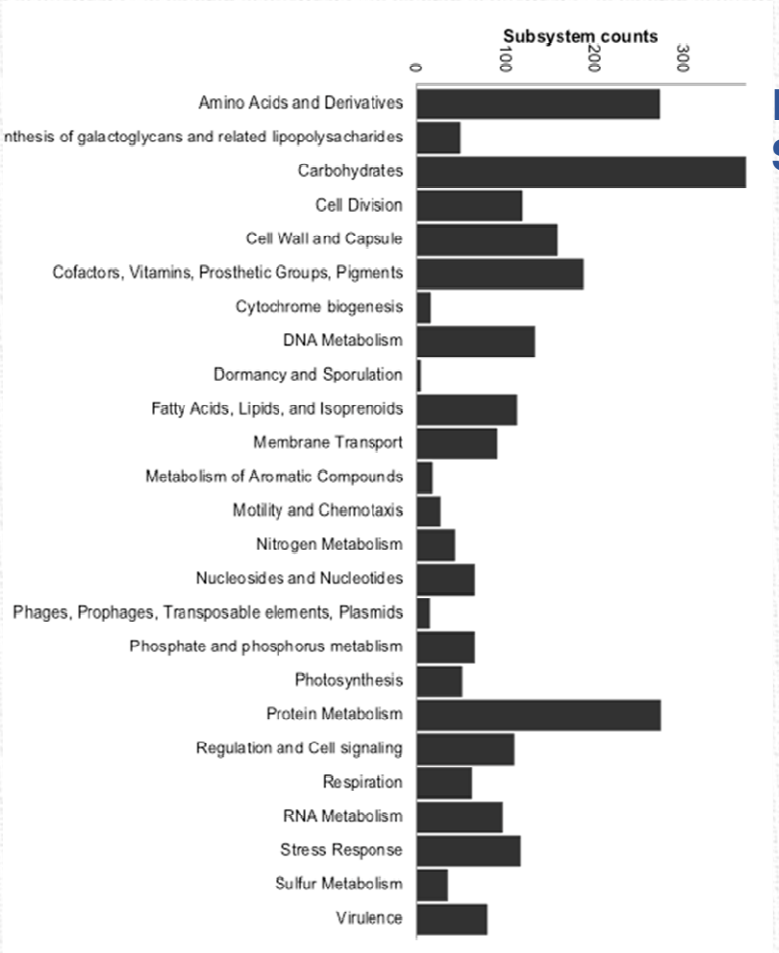
AMERICAN SOCIETY FOR MICROBIOLOGY | genomeAnnouncements™

Draft Genome Sequence of the Axenic Strain *Phormidesmis priestleyi* ULC007, a Cyanobacterium Isolated from Lake Bruehwiler (Larsemann Hills, Antarctica)

Yannick Lara,[a] Benoît Durieu,[a] Luc Cornet,[b,c] Olivier Verlaine,[a] Rosmarie Rippka,[d] Igor S. Pessi,[a] Agnieszka Misztak,[b] Bernard Joris,[a] Emmanuelle J. Javaux,[c] Denis Baurain,[b] Annick Wilmotte[a,e]



RAST: Rapid Annotations using Subsystems Technology

Aziz et al., BMC Genomics, 2008

Total length : 5 684 389 bp

Annotation:
5,604 PEGs (protein encoding genes) of which 4,785 PEGs already known

Number of ULC007 genes in each subsystem

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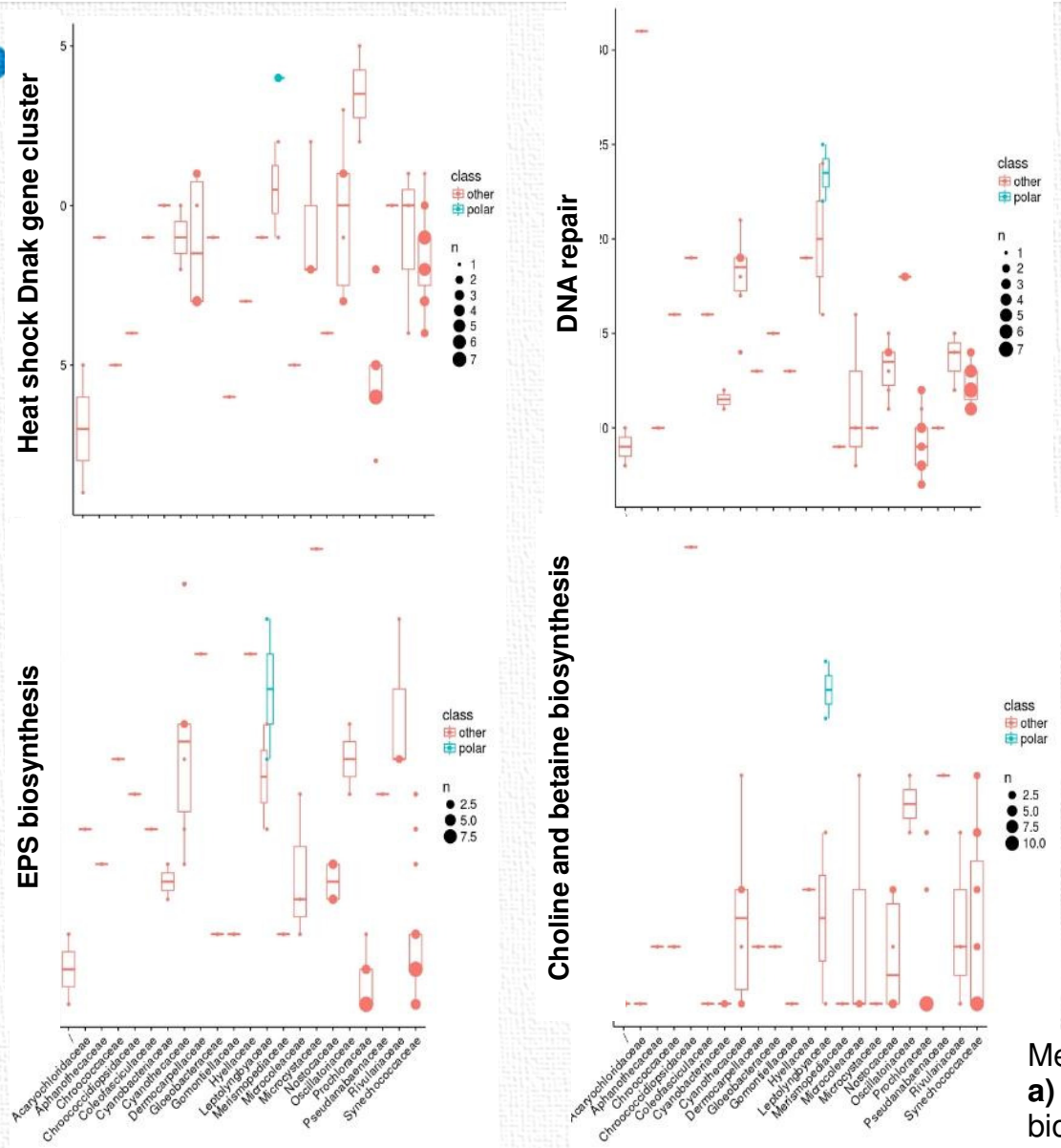

Taxonomy (families sensu Komarek et al. 2014)

69 complete and representative genomes
+ *Leptolyngbya boryana* PCC 6306
+ *P. priestleyi* BC 1401 (Arctic)

Even within the Leptolyngbyaceae family, the 2 polar genomes (blue) have **highest number of genes** in the 4 functional categories involved in response to cold stress

Median and quartile of occurrence for 4 subsystems : **a)** DnaK gene cluster, **b)** DNA repair, **c)** EPS biosynthesis, **d)** Choline and betaine biosynthesis.

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In Polar regions, low temperatures induce **molecular and cellular disturbances** (e.g. rigidity of membranes, reduction of enzyme-catalyzed reactions, inefficiency of solute transports). Therefore, these harsh conditions select organisms that present particular adaptations.

Our results underline the presence in its genome of functional categories of genes involved in the **production of key molecules** (e.g. exopolysaccharides, fatty acids and the chaperone). These molecules limit cellular and biochemical damages (e.g. EPS protect against freezing by buffering temperature fluctuations around 0°C, fatty acids decrease membranes rigidity).

The success of *P. priestleyi* ULC007 could be explained by different **functional processes** such as exopolysaccharide (EPS) biosynthesis, DNA repair, osmoprotection, etc.

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Cooperation Y. Lara, ULiège

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Bioactivity of ULC026

Antibiotic effect of strain ULC026 against the fungi *Phoma*

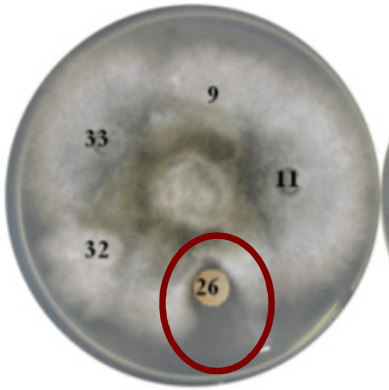

Fig. 3. *Phoma*

Antibiotic effect of strain ULC026 against the fungi *Cercospora*

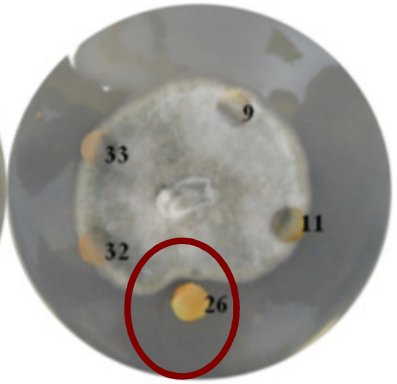

Fig. 4. *Cercospora*

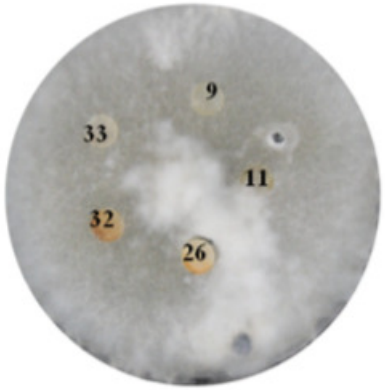

Fig. 5. *Sclerotinia*

Bilaterial cooperation (FNRS/CNPq) with Estella Stenico and Marli de Fatima Fiore (CENA, Piracicaba)

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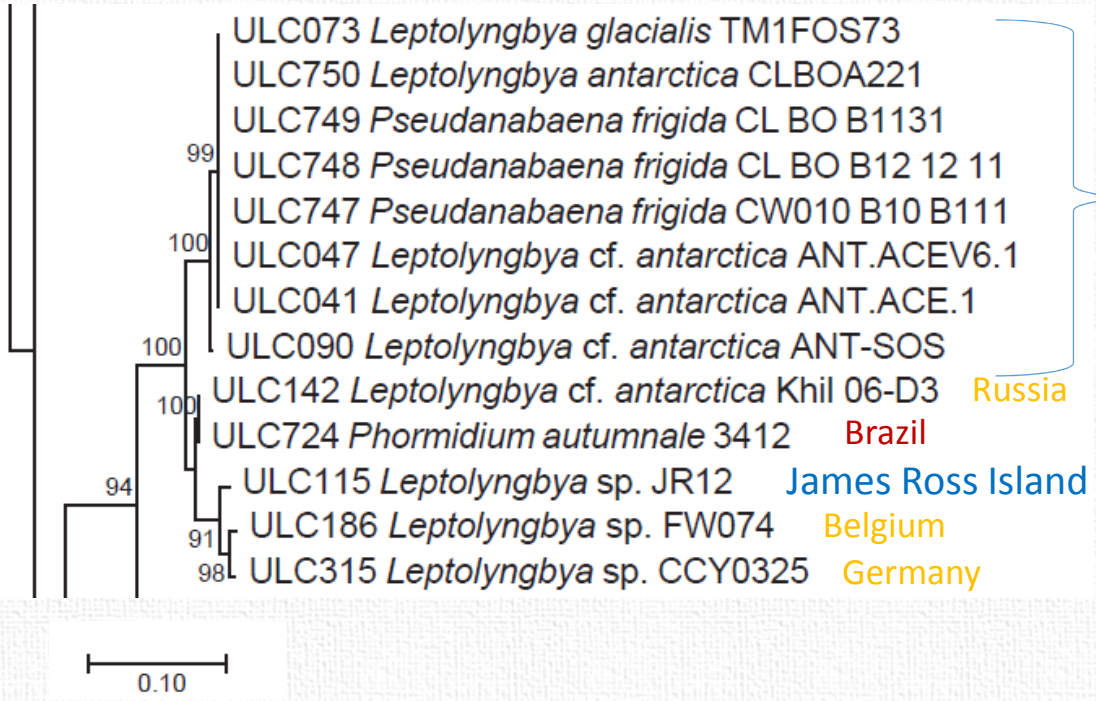
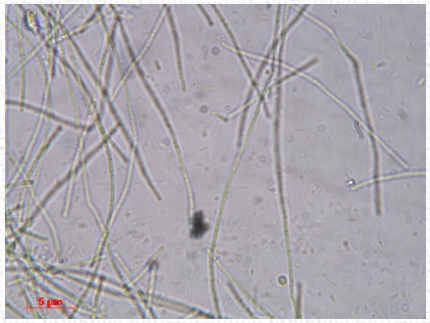
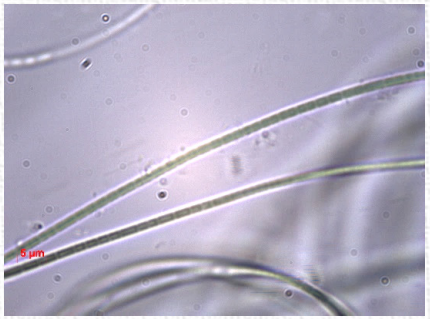
Filamentous genera: 9 Antarctic strains





Prydz Bay, Enderby Land,
McMurdo Ice Shelf,
Transantarctic Mountains



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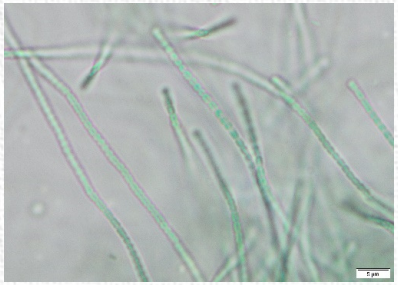
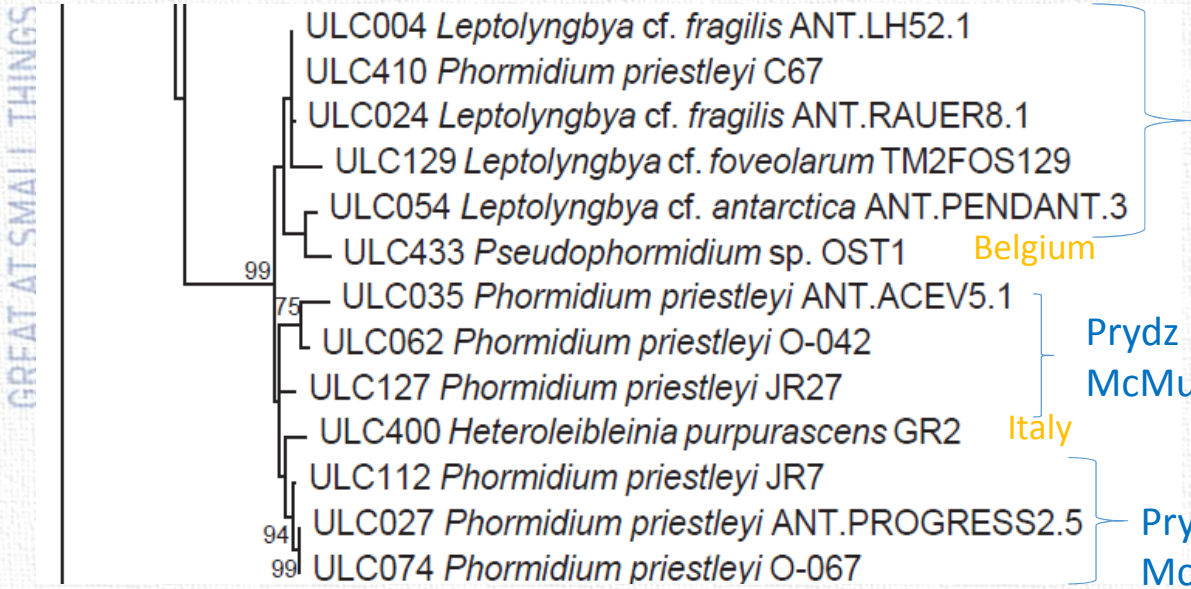
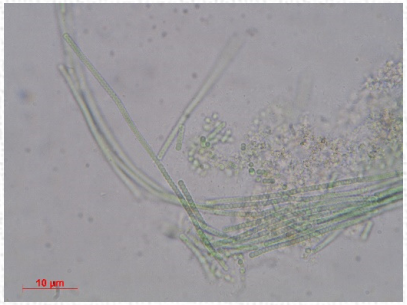
Filamentous genera: 11 Antarctic strains





Prydz Bay and Transantarctic Mountains

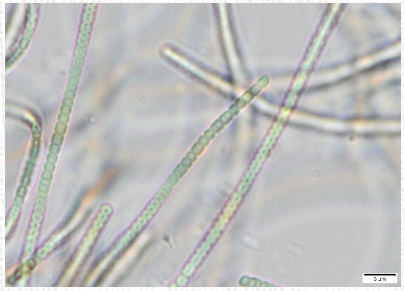
Belgium



Prydz Bay, James Ross Island and McMurdo Ice Shelf

Italy

Prydz Bay, James Ross Island and McMurdo Ice Shelf



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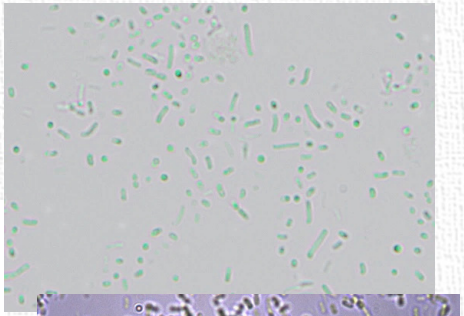
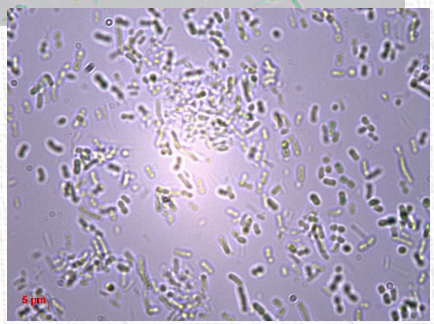
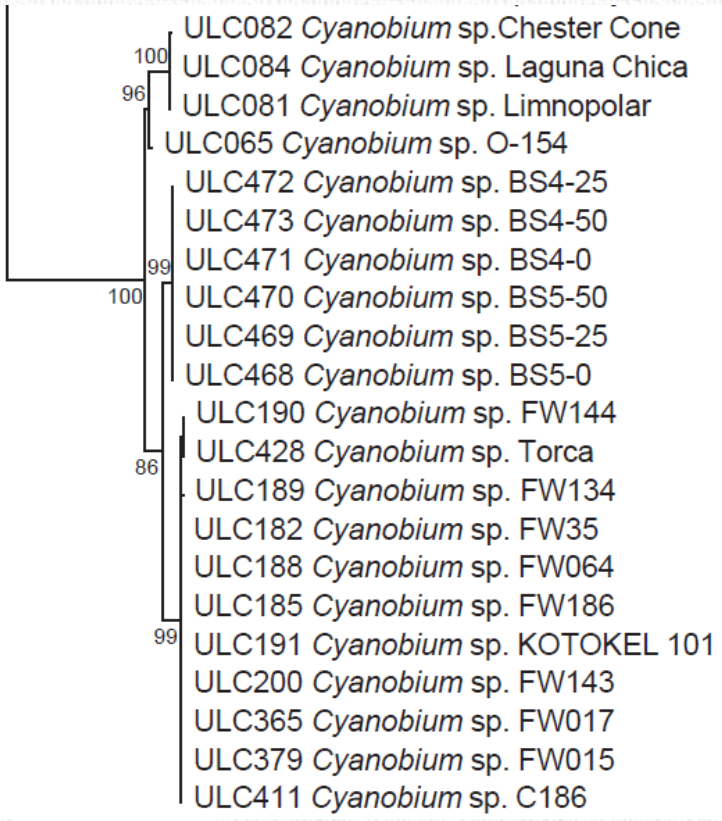
Synechococcales genera: 10 Antarctic and 1 Arctic strain







Antarctic Peninsula

Canada Arctic

Europe,
Russia, Chile

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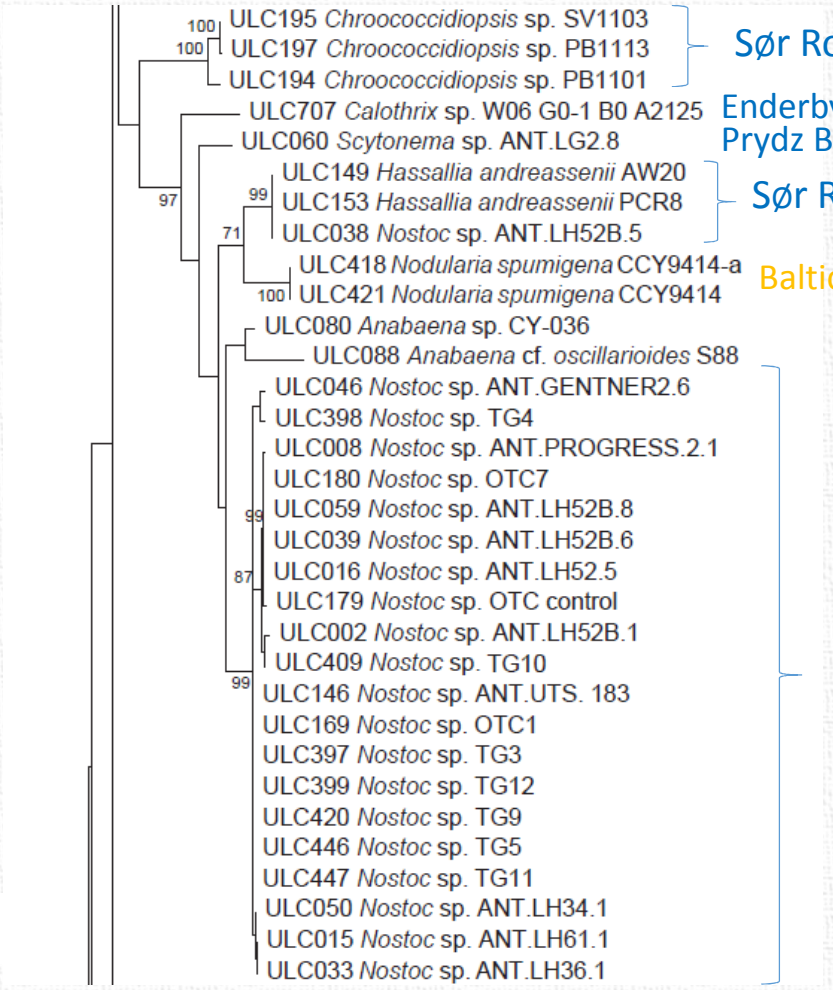
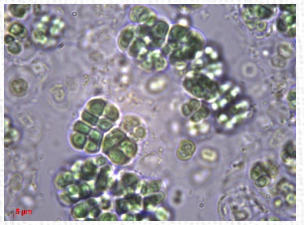
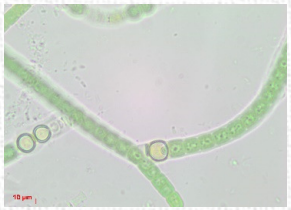
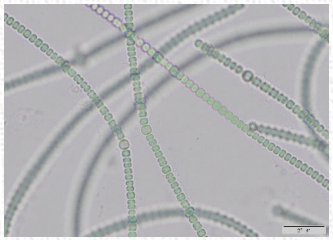
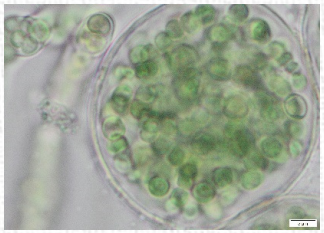
Chroococcidiopsidales + Nostocales genera: 28 Antarctic strains

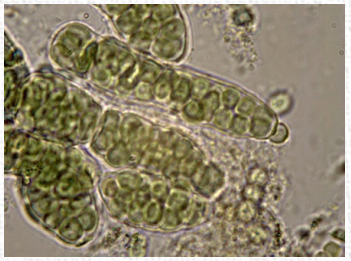












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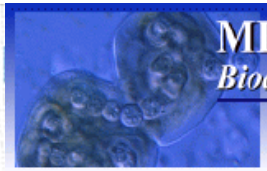

MICROMAT
Biodiversity of Microbial Mats in Antarctica

Cyanobacterial hits

16rRNA OTU	Morphotype	Identification	Hits	Activity on *S.aureus*	Activity on *A.fumigatus*	Activity on *C.neoformans*	Cytotoxicity
16ST03 New	OS-II	*Phormidium pristleyi*	ANT. LH52.1 ULC007	0	512	1024	0
16ST03 New	OS-II	*Phormidium pristleyi*	ANT. LH52.1 ULC026	8	512	512	160
16ST01 New	OS-I	*Pseudo phormidium* sp.	ANT. PROGRESS 2.2 ULC009	64	0	512	640
16ST13 Ant	OS-V	*Leptolyngbya antarctica*	ANT. GENTNER 2.3	64	0	0	640
16ST19	NO-I	*Nostoc* sp.	ANT. LH34.1 ULC050	8	0	0	0

Microbiological activity: the highest dilution which inhibits 80%of the pathogen growth

Cytotoxicity: the highest dilution which inhibits 40% of HeLa cell thymidine uptake

Biondi et al. 2008

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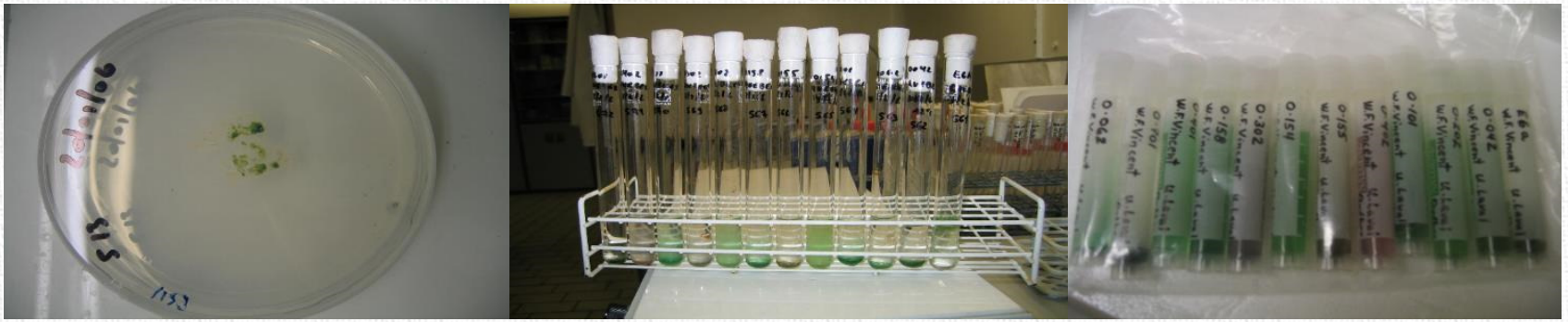

→ Renewed interest for biotechnological exploitation of cyanobacteria, with a steadily increasing number of Antarctic cyanobacteria found to produce a variety of biologically active compounds

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Policy view on bioprospecting

→ Current discussion at ATCM level concerning the exploitation of Antarctic genetic ressources and how this fits with the Antarctic Treaty and the Madrid Protocol. Belgium has been active on this topics from 2007 to 2014:

WP11 at ATCM31
WP01, WP26 and IP70 at ATCM32
WP01 at ATCM33
IP22 and IP63 at ATCM35
WP48 and IP22 at ATCM36
WP12 at ATCM37

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In 2009, Belgium (Federal Ministry of Environment) and the United Nations Environment Programme (UNEP) decided to create a database on bioprospecting activities in Antarctica: **Bioprospector**
It has been developed by the United Nations University Institute of Advanced Studies (UNU-IAS) on basis of public information, and was freely accessible on the Internet. It was discontinued due to lack of financing.

187 records in 2009

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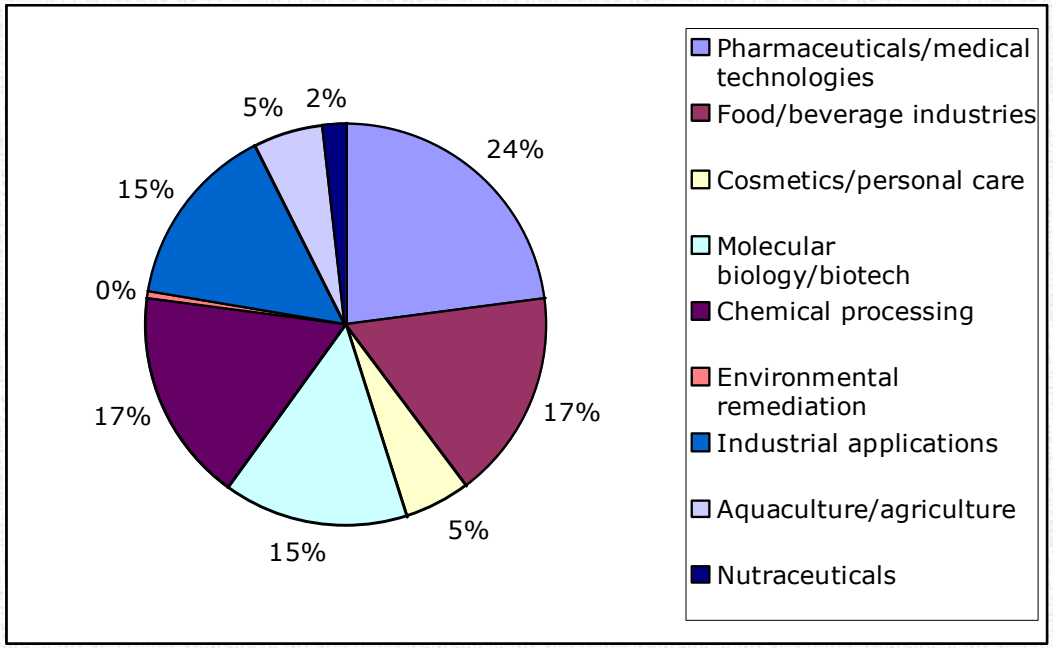
UNU/IAS database on bioprospecting in Antarctica

www.bioprospector.org/bioprospector/Antarctica/home.action



Users of Antarctic genetic ressources

Source: UNU & Federal public service Health, Food chain safety and Environment (Belgium), as contribution to the discussion of the Committee of Environmental Protection of the Antarctic Treaty on bioprospecting

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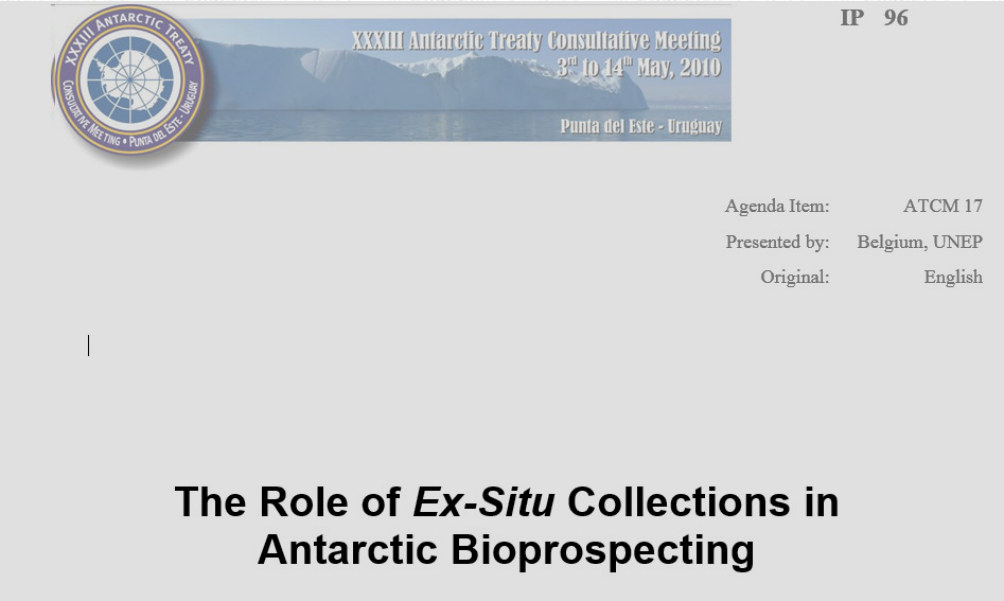

Antarctic bioprospecting is a reality and the current 'status quo' cannot be prolongated indefinitely in view of what is happening in other international fora like the Convention on Biological Diversity.

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Many thanks to RW Castenholz, W. Vincent, J. Elster, L. Kovacik, H.D. Laughinghouse, Z. Namsaraev, Y. Lara, R. Fernandez-Carazo, P. De Carvalho Maalouf, MJ Mano, G. Tahon for deposits

Bioassays for bioactive compounds

Bilaterial cooperation (FNRS/CNPq) with Estella Stenico and Marli de Fatima Fiore (CENA, Piracicaba). Thanks to Magda Calusinska

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