

Isolation and characterisation of heterotrophic microorganisms from mineral soils of Livingston Island (Antarctica) and Store Koldewey (Northeast-Greenland).

Microbial communities in extreme habitats like the Arctic and Antarctic are still insufficiently investigated. Only little information is available about diversity and function in such environments. Because of their geographic isolation, climatological specialities and the minor anthropogenic influence, polar regions provide a unique opportunity as a natural laboratory for studying the functional diversity of microbial life under extreme environmental conditions.

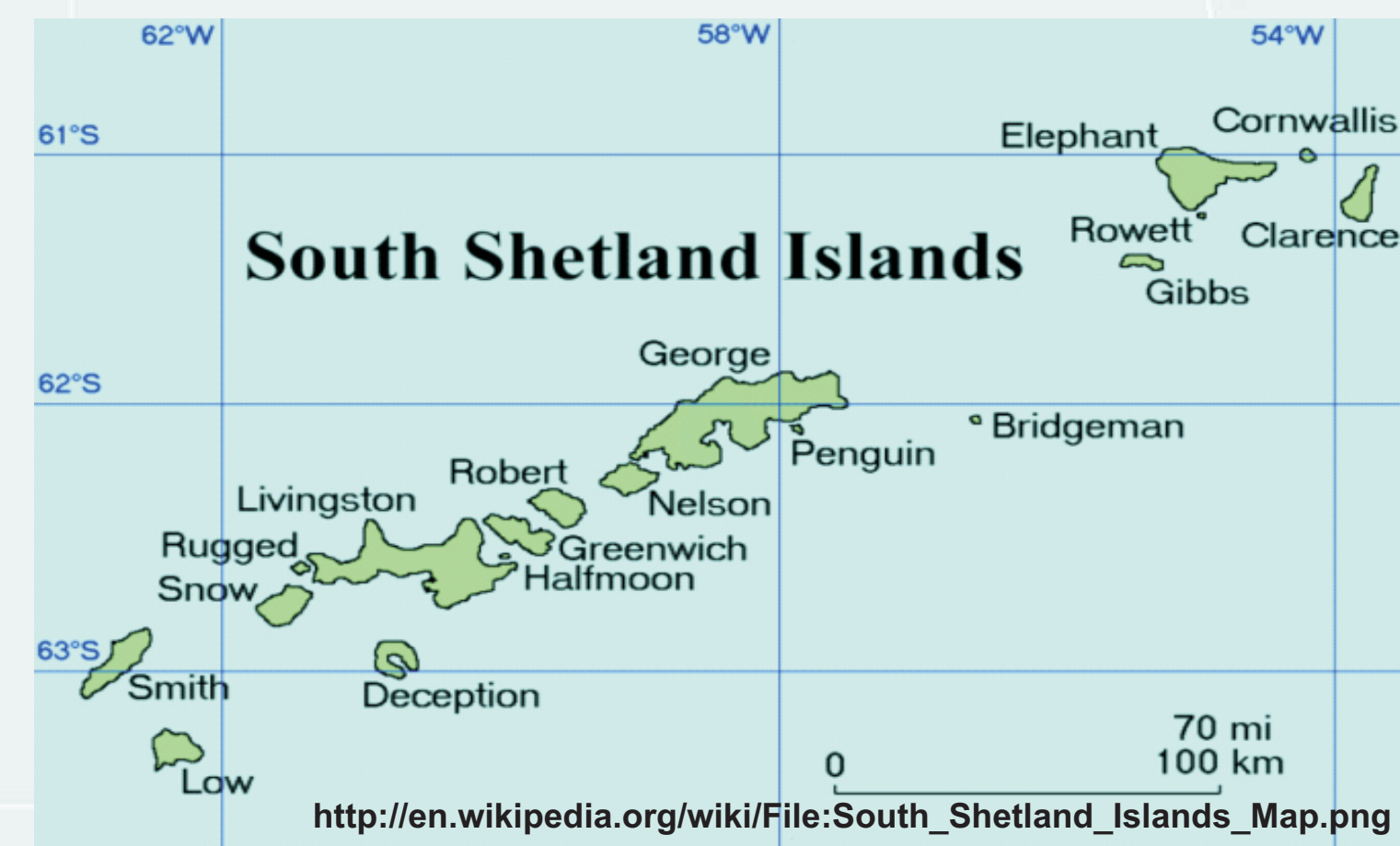
Study sites

Store Koldewey (Arctic/Northeast-Greenland)

<http://www.uni-leipzig.de/~geologie/Forschung/Projektseiten/UmweltGroenl/Groenland1.jpg>, modified



Livingston Island (South Shetland Islands/Antarctica)



The polar climate on Store Koldewey is characterised by low temperatures varying between -24°C and 4°C and little precipitation around 150mm pa. Because of the harsh climate conditions only initial soil formation can be observed.

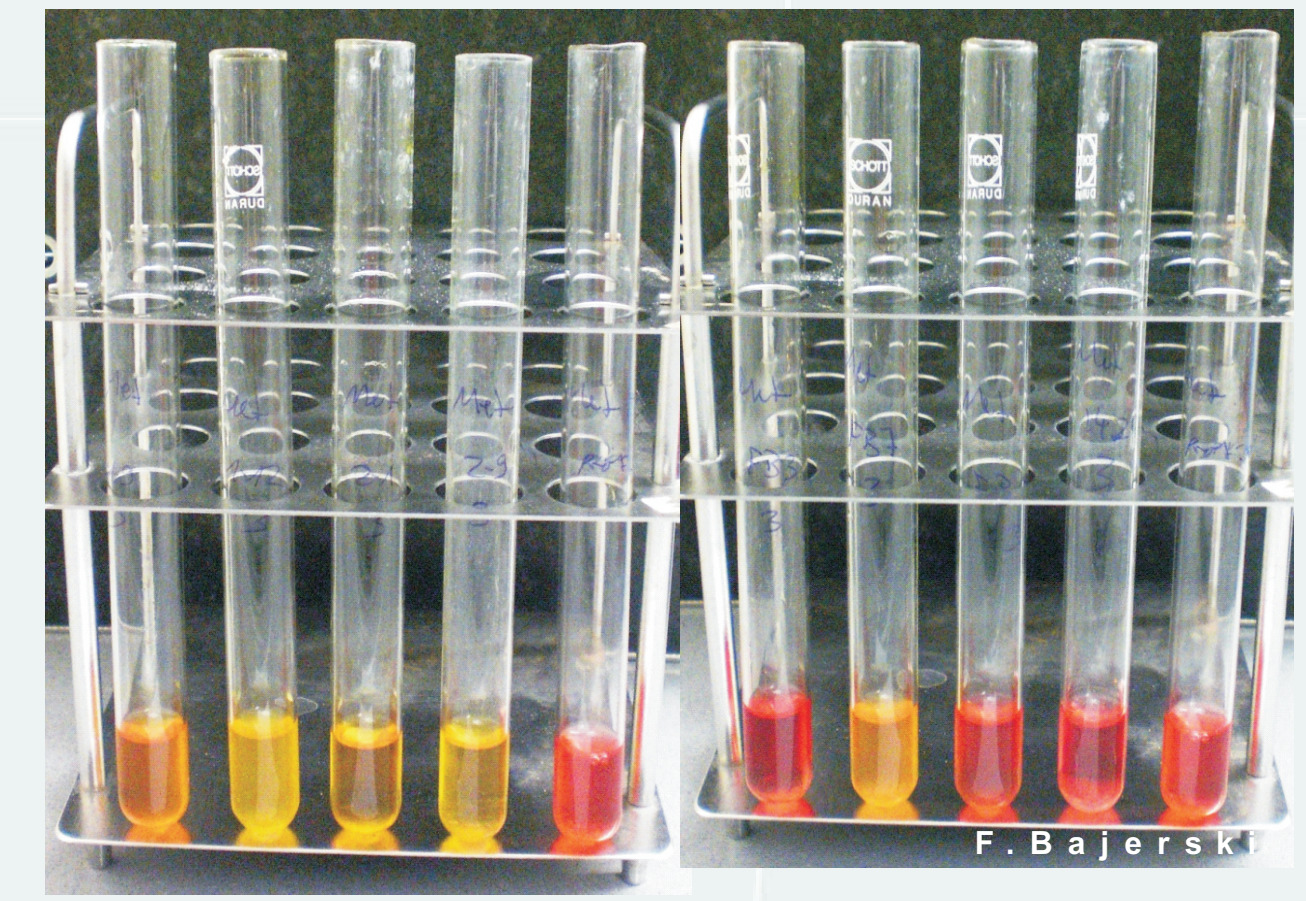
The cold-maritime climate of Livingston Island is characterised by low temperatures from -10°C down to -35°C in winter and up to 10°C in summer. The annual precipitation averages around 500mm and is evenly distributed throughout the year. Environmental conditions and low input of organic material result in initial soil formation processes, e.g. humus accumulation or clay formation.

Methods



Soil profile T1-1 (0-14 cm depth) from Livingston Island: Silty sand in a bedrock depression, covered with a moss layer

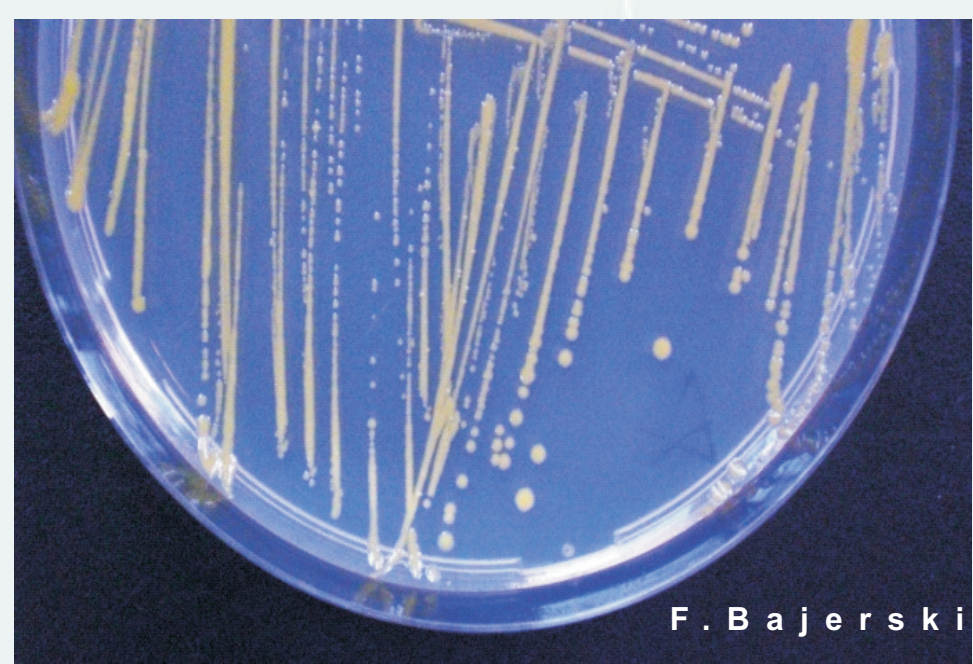
Enrichment cultures from both study sites could be obtained by plating soil solutions on BR-media (Bunt-Rovira, 1955). Several heterotrophic aerobic bacteria were isolated and cultivated at 10°C . Amplification of the 16S rRNA genes was carried out using the primer pair E8F and 1492R to determine the molecular phenotype and for the phylogenetic characterisation of selected isolates. Morphological, physiological and biochemical analyses were performed to describe the phenotype of certain strains.



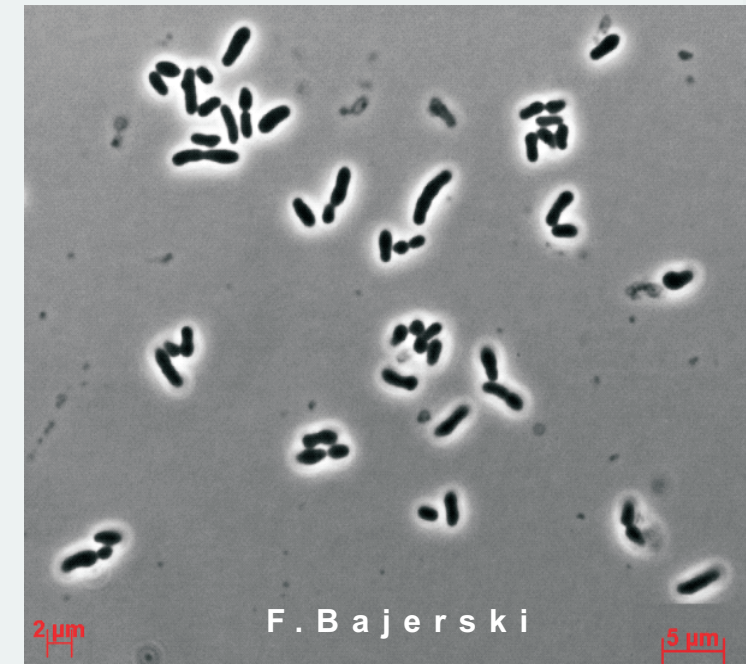
Biochemical analyses: Methyl-red-test (LI-1, LI-2, LI-3, LI-4, positive control (pc), SK-1, SK-2, SK-3, SK-4, pc)

Results and conclusion

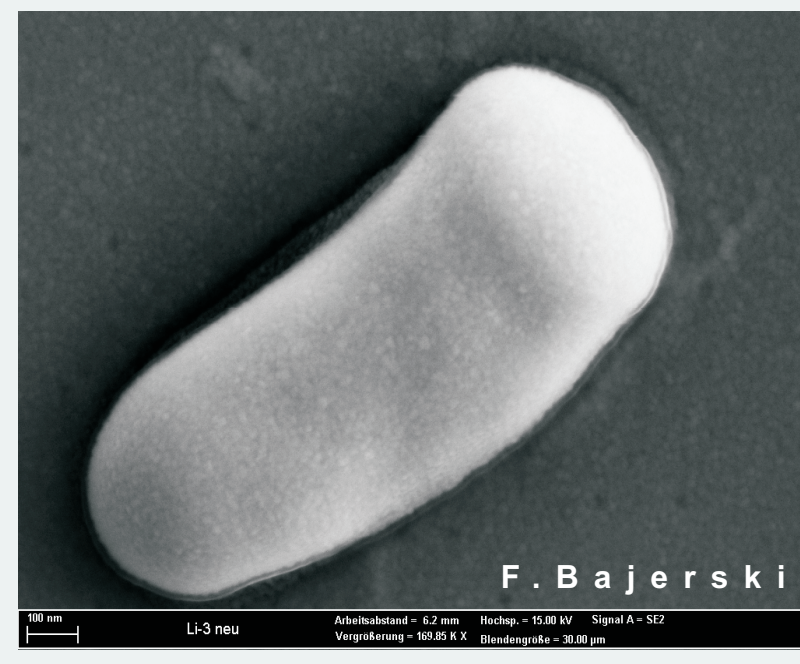
Arthrobacter cryotolerans LI-3



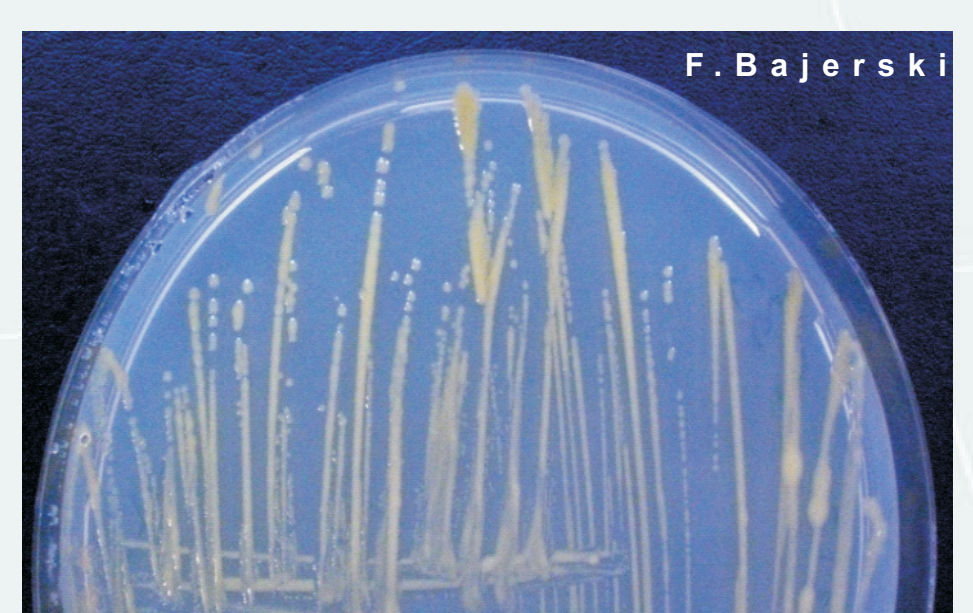
Colonies and inoculum



Cell shape: Phase Contrast Microscopy



Raster Electron Microscopy



Cryobacterium arcticum SK-1

In the scope of this work we succeeded in enriching, isolating and characterising several heterotrophic bacteria in general, as well as an elaborate description of eight selected strains. Considering the current results of our research, we propose *Arthrobacter livingstonensis* sp. nov. LI-2^T and *Arthrobacter cryotolerans* sp. nov. LI-3^T as two novel species in the genus *Arthrobacter*. We report the isolation and identification of strain *Cryobacterium arcticum* sp. nov. SK-1^T as a novel psychrotolerant species in the genus *Cryobacterium*. Strain LI-1^T could be classified as a novel species in the genus *Leifsonia*, named *Leifsonia psychrotolerans*.

character	LI-1	LI-2	LI-3	LI-4	SK-1	SK-2	SK-3	SK-4
length (µm)	0.5-2.5	0.5-2.0	0.4-2.5	2.0-10.0	0.4-2.0	2.5-8.0	2.0-3.5	0.8-2.7
width (µm)	0.3-0.5	~0.5	0.3-0.5	0.5-0.8	0.2-0.4	~0.2	0.4-0.6	0.5-0.8
gram-reaction	-	+	+	+	+	-	-	-
cell-form	rods	rods	short rods	rods	irregular rods	rods	rods (form v-shaped pairs)	rods
temperature-range	-6 to 28°C	-6 to 28°C	-6 to 24°C	5 to 28°C	-6 to 28°C	0 to 28°C	-6 to 28°C	5 to 28°C
temperature-optimum	16°C	16°C	16°C	16°C	20°C	20°C	16°C	24°C
pH-range	4.5 to 9.5	4.0 to 9.5	4.0 to 9.5	6.0 to 8.5	5.0 to 9.5	5.0 to 9.0	5.0 to 9.0	4.0 to 11.0
pH-optimum	5.5 to 6.5	7.5 to 8.0	6.5	7.5	6.5 to 7.5	6.5	8.0	6.0 to 6.5
NaCl-tolerance	0-4%	0-9%	0-9%	0-6%	0-3%	0-1.5%	0-4%	0-6%
NaCl-optimum	1-2%	0-1%	0.5-3%	0-2%	0%	0.5%	0-1.5%	0%
presence of O ₂	aerobic	aerobic, (fac. anaerobic)	aerobic (fac. anaerobic)	aerobic (fac. anaerobic)	aerobic	aerobic, (fac. anaerobic)	obligate aerobic	aerobic
amylase	+/-	-	-	-	-	+	-	-
protease	-	+/-	-	+/-	-	++	-	++
indol-production	-	-	-	-	-	-	-	-
H ₂ S-production	+	+	+	+	+	+/-	-	-
urease	-	+	-	+	-	-	-	-
catalase	+	+	+	+	+	-	+	+/-
oxidase	-	-	-	-	-	+	-	+/-
methyl-red-test	+/-	-	-	-	+	-	+	+

Phenotypic characteristics of the eight selected strains (+ positive, - negative, +/- weak reaction, ++ strong reaction)

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