

AB:327; Arctic Microbiology (Summer 2010)

Course leader Dr. David Pearce

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The course will give an understanding of the role of microorganisms in ecosystem function in the Arctic Region (particularly with respect to nutrient cycling). In the practical part, students will focus on measuring important processes in the carbon and nitrogen cycles and use the latest molecular biological techniques for the detection and characterization of specific bacteria in typical Arctic environments.

Content:

The course will give an introduction to environmental microbiology and microbial ecology under the extreme conditions of the Arctic, at the limits of habitability. The main part of the course will deal with the role of micro-organisms in transforming the most important nutrients in the Arctic, focussing on the terrestrial and marine environments. Sites close to Longyearbyen on Svalbard will be used to illustrate processes in Arctic terrestrial ecosystems. Production and utilisation of methane and nitrogen cycling, including nitrogen fixation, will be measured both in the field and in the laboratory. The latest molecular techniques based on DNA will be used to profile and detect specific microorganisms. The Barents Sea will be used as an example for processes in a marine environment - in Arctic seas, large amounts of organic matter accumulate due to slow microbial degradation and this will be investigated. During the course, students will measure total bacterial counts, biomass, microbial activity, isolate and cultivate microorganisms and investigate structure, biodiversity and stability, in Arctic microbial communities.

Course outline:

Theory (5 days)

1. Arctic microbial biodiversity – the diversity of Arctic microbial life, extremophiles and cold adaptation, Arctic habitats for microbial growth
2. Methods in Arctic microbiology - classical microbiology techniques (as applied to Arctic ecosystems), the latest molecular methods, bioinformatics and information technology, economics – biotechnology, bioremediation and bioprospecting
3. Arctic biogeochemistry and nutrient cycles - energy and metabolism, nutrient cycles, geomicrobiology,
4. Arctic microbial ecology - trophic structure, food webs, feeding relationships, energy transfers, interactions, colonization and establishment, evolution, genetic stability and gene transfer
5. Hot topics in Arctic microbiology – the effects of climate change, environmental change, human impact, biogeography and microbial diseases

Practical (6 days)

Theme 1 Detecting life at low levels

Theme 2 Investigating new or unfamiliar Arctic environments

Theme 3 Investigating selection pressures in a range of Arctic environments

Fieldwork (6 days)

Marine focus (using UNIS boat Viking Explorer) CTD, Sediment cores, Fjord transect

Terrestrial focus (Polarcircle rib boat and minibus) Inner Fjord, Outer Fjord, Methane experiments in situ

A wide variety of habitats exist within the Arctic for microbial growth and the Arctic Microbiology Course will investigate a number of key examples;



Soil and rock



Fresh and glacial meltwater



Brackish water and melt pools



Marine and air



Biofilms and other organisms



Snow and ice

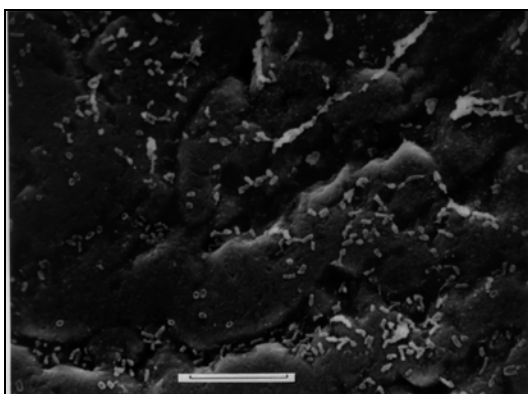
In order to do this, we will employ a variety of microbiological techniques;



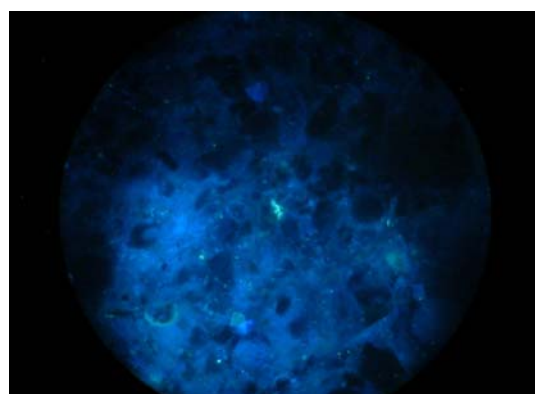
Field sampling techniques



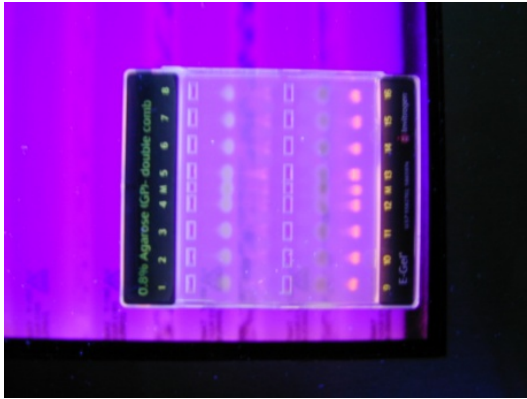
Microbiological sample handling



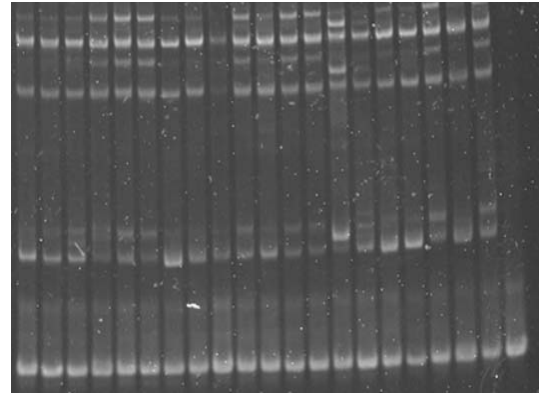
Culture and selection



Microscopy and staining



In situ analysis – what can we do in the field



Methods of community profiling

Photographs courtesy of D.Pearce (BAS) and Malu Avila (UNIS)