

TITLE: **Biodiversity of eukaryotic microorganisms in polar ecosystems: exploration, function and exploitation**

CONTACT PERSONS AND INFORMATION:

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DESCRIPTION OF BELGIAN CONTRIBUTION:

In the absence of higher plants and metazoa, eukaryotic microbes play a crucial role in Antarctic ecosystems, especially in the freshwater and terrestrial environments. In the Arctic as well, they form a dominant component of freshwater and marine ecosystems. To date, little is known on the biodiversity of polar eukaryotic microbial communities, although various studies (e.g. Sabbe et al. 2003) have already indicated that microbial diversity is surprisingly high and comprises many organisms that are unique to Antarctica. **Key questions** with respect to the microbial diversity of the polar regions are (1) **how unique are the microbial biota of the polar regions ?** (2) **how have they evolved ?** (3) **how are they adapted to their extreme habitat?** And (4) **what is the potential for pharmaceutical and biotechnological exploitation of this microbial diversity?**

The Section Protistology & Aquatic Ecology (Ghent University) has a long-standing expertise in the study of the **biodiversity and evolution of eukaryotic micro-organisms** from freshwater and marine environments using traditional and molecular methods, and has experience in Antarctic research in the framework of national and international programs. We closely cooperate with Belgian, European and Australian laboratories in these projects, and have worked together with European pharmaceutical and biotechnologies SME's for the screening of Antarctic micro-organisms for novel compounds.

The recent, explosive growth of global sequence databases allows better phylogenetic evaluation of the affinities of polar microbiota (especially in comparison with biota from temperate and tropical alpine habitats), and hence of their uniqueness. We propose to study selected model systems (from various key groups, such as sea ice and freshwater diatoms and green algae); selection will a.o. be based on their ecological importance. This molecular-phylogenetic evaluation will create a framework which can be used to unravel the evolutionary processes that have shaped polar microbial communities, i.e. how important processes such as isolation, speciation, colonization and dispersal are on various timescales (see also below), and in contrasting environments (marine vs freshwater, terrestrial vs aquatic). It is assumed that many polar microbial species are highly adapted to their extreme environments. Studying their physiological adaptations to e.g. cold temperatures, hypersalinity or low light will form the basis of molecular-genomic studies aimed at dissecting the molecular mechanisms underlying these adaptations. In addition, we envisage ample possibilities for cooperation with SME's for the discovery of novel compounds for biotechnological or pharmaceutical applications.

ADDED VALUE IF ADOPTED BY IPY07

The present proposal contributes to all of the three overarching themes proposed by the Planning Group for IPY 2007/8. **Exploration of New Frontiers:** we will look at microbial diversity through a glacial-interglacial cycle, which will contribute to our understanding of colonisation and extinction processes in Antarctica. **Understanding Change at the Poles:** by studying the response of the terrestrial environment to climate changes we will obtain information about the resilience of these ecosystems and establish a framework to which the modern temperature rise in Maritime Antarctica can be evaluated. **Decoding Polar**

**Processes:** We will obtain a better understanding of the influence of the Antarctic region on global climate changes through the analysis of high-resolution records.

There are strong indications that polar environments are changing fast, most probably as a result of global climate warming (see below). It is imperative that we understand how polar (microbial) ecosystems function in order to predict the effects of change at the poles, and this requires a thorough understanding of the key microbial components. In order to understand ecosystem processes and the biogeochemistry of these environments, we need to improve our knowledge of the biology of these organisms, and how they function in these extreme habitats. We propose to combine baseline descriptive and experimental studies to enhance our knowledge of the functioning of polar microbial communities.

#### CONCEPTS FOR CROSS-CUTTING ACTIVITIES

As already indicated above, our research has relevance for other polar research themes, such as paleoclimatology and paleoecology. In addition, the study of microbial diversity offers promising prospects with respect to the pharmaceutical or biotechnological exploitation of novel compounds isolated from organisms living in extreme environments.

#### EXISTING PARTNERSHIPS

##### National

Prof. Dr. Annick Wilmotte - Université de Liège  
Prof. Dr. Marc De Batist - Renard Centre of Marine Geology, Ghent University  
Prof. Dr. Nathalie Fagel - Université de Liège, URAP  
Prof. Dr. J. Swings – Ghent University

##### International

Dr. Dominic A. Hodgson – British Antarctic Survey (UK)  
Dr. Mike Bentley and Dr. Glenn Milne – University of Durham (UK)  
Prof. Dr. Andrew McMinn and Dr. Donna Roberts – IASOS University of Tasmania (AUS)  
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