Oceanologia (2017) xxx, xxx–xxx

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ORIGINAL RESEARCH ARTICLE

Comparison of bacterial production in the water column between two Arctic fjords, Hornsund and Kongsfjorden (West Spitsbergen)

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Received 15 August 2016; accepted 10 June 2017

KEYWORDS
Bacterial production;
Arctic fjords;
Spitsbergen;
Hornsund;
Kongsfjorden

Summary Bacterial production and the accompanying environmental factors were measured in the water columns of two Arctic fjords during the cruise in July and August 2013. Water samples were collected at six stations located in the central part of Hornsund and Kongsfjorden. In Hornsund, where average water temperatures were 1.25-fold lower than in Kongsfjorden, the bacterial production was twice as high (0.116 ± 0.102 vs 0.05 ± 0.03 mg C m^{-3} h^{-1}). Statistical analysis indicated that chlorophyll *a* concentration itself was not a significant factor that affected bacterial production, in contrast to its decomposition product, pheophytin, originating from senescent algal cells or herbivorous activity of zooplankton. Single and multiple regression analysis revealed that water temperature, dissolved organic carbon (DOC), and pheophytin concentration were the main factors affecting bacterial production in both fjords.

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Peer review under the responsibility of Institute of Oceanology of the Polish Academy of Sciences.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.oceano.2017.06.001

1. Introduction

Polar regions are extremely important research fields because of their unique vulnerability to climate change. One of the already visible and predicted signs of global warming is intensive retreat of glaciers. Due to glacial meltwater inflow, and therefore particulate matter (Urbański et al., 2017) and freshwater introduction, changes were observed in the microbial community composition in the Arctic fjords (Piquet et al., 2010, 2016).

Fjords of Hornsund (located on the south-west coast of Spitsbergen, Fig. 1) and Kongsfjorden (located on the north-west coast of Spitsbergen) were selected as sites where monitoring of the implications of climate change is possible (Warwick et al., 2003) due to their location in the area of increasing air temperature as well as inflow of Atlantic Waters (AW) (Serreze et al., 2000; Walczowski and Piechura, 2006, 2007, 2011; Walczowski et al., 2012). Kongsfjorden remains under strong influence of warm and saline West Spitsbergen Current. It follows the deeper part of the Fram Strait, and often enters the fjord, causing warming of its environment (Cottier et al., 2005; Svendsen et al., 2002). The South West coast of Spitsbergen is more affected by coastal Arctic waters from the Barents Sea which are less saline (Skagseth et al., 2008). This so called Sørkapp Current has great influence on the Hornsund Fjord (Cottier et al., 2005; Swerpel, 1985).

Research carried out in recent years in the polar regions shows that low temperature is not a limiting factor of bacterial activity (Kirchman et al., 2005; Rivkin et al., 1996). Many authors highlight the need to combine conventional techniques of determining bacterial production (based on the incorporation of ^{3}H-thymidine or ^{3}H-leucine) (Fuhrman and Azam, 1982; Kirchman et al., 1985; Simon and Azam, 1989) with single-cell analysis to identify the capability for assimilation of dissolved organic matter (DOM) by individual groups of bacteria (Elifantz et al., 2007).

The total abundance, biomass, and morphological structure of bacterioplankton can be evaluated by means of the direct cell counting technique, without the need of bacteria cultivation (Amann et al., 1995). In recent years, intensive development of non-cultivating techniques has contributed significantly to the expansion of knowledge on microbial diversity and community composition in the environment (Piquet et al., 2010, 2016; Zengler, 2009).

Although Kongsfjorden BP data are available for several seasons and years (Engel et al., 2013; Iversen and Seuthe, 2011; Motegi et al., 2013; Piquet et al., 2016; Wängberg et al., 2008), no information is to date available on BP in Hornsund. Experiments regarding the impact of climate change on microorganisms also were conducted in Isfjorden, under the influence of the Atlantic Waters (Lara et al., 2013).

Despite this multi-annual overview on the functioning of West Spitsbergen fjords, the details of microbial processes are still not fully understood. An interdisciplinary approach, combining hydrology, chemical composition of glacial and surface runoff, as well as and metagenomic data, is necessary to establish the scale of impact of biotic and abiotic factors

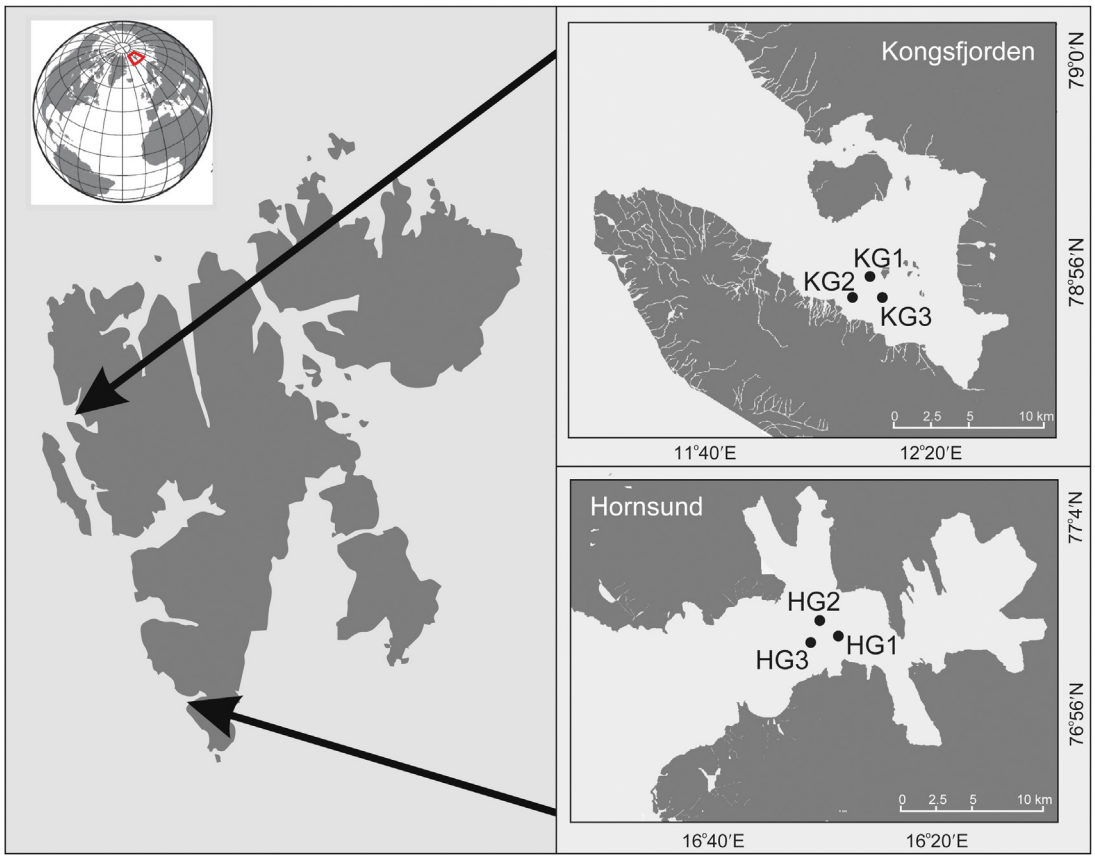

Figure 1 Maps of sampling points (GAME data).

Please cite this article in press as: Ameryk, A., et al., Comparison of bacterial production in the water column between two Arctic fjords, Hornsund and Kongsfjorden (West Spitsbergen). Oceanologia (2017), http://dx.doi.org/10.1016/j.oceano.2017.06.001