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Spring-time dynamics of diatom communities in landfast and underlying platelet ice in Terra Nova Bay, Ross Sea, Antarctica

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A B S T R A C T

We investigated the composition of diatom communities in annual fast ice and their variations over time during the 1999 austral spring in Terra Nova Bay (Ross Sea, Antarctica). Diatoms varied along the ice core in both cell abundance and species composition, with a minimum in the lower layer and a peak in the platelet ice. Planktonic species constituted in total about 98% of the diatom assemblage in the surface layers of the ice core down to the thickness of 220 cm. In the bottom ice and the underlying platelet-ice layer, the contribution of planktonic diatoms was lower (60% and 65%, respectively) at the beginning of the sampling period, and then decreased further to reach 30% in the bottom ice, where a remarkable biomass increase over time was caused by in situ growth and accumulation of benthic species.
By contrast in the platelet-ice layer only small changes were recorded in the composition of the diatom assemblage, which was mainly constituted by the bloom of *Fragilariopsis nana*. The benthic species are generally not found in the water column, while species in the platelet-ice layer presumably constitute the seed for the initial plankton bloom during the ice-free periods in Terra Nova Bay.

1. Introduction

Annually formed sea ice is the main feature of the polar regions and plays a fundamental role in structuring marine ecosystems at high latitudes, thus affecting the interactions between the ocean and the atmosphere as well as influencing global climate (Eicken, 1992; Thomas and Dieckmann, 2002; Smetacek and Nicol, 2005). Sea ice is a complex matrix containing channels, capillaries and pores, intimately connected with the underlying water column, and represents a harsh physico-chemical environment characterized by steep gradients in temperature, salinity, light and nutrient concentrations (Eicken, 1992; McMinn et al., 1999; Thomas and Dieckmann, 2002). Nevertheless, diverse microbial communities, known as the sympagic biota, are able to survive in the brine inclusions and interstices of the sea ice habitat (e.g. Arrigo, 2014).

The most conspicuous members of the sea ice microbial communities are the microalgae that are adapted to live in extreme conditions and flourish within the distinct micro-habitats that are created when the sea ice forms and develops (Lizotte, 2003; Arrigo and Thomas, 2004; Lavoie et al., 2005; Mock and Thomas, 2005; Matsuoka et al., 2009). The microalgae living in the annual pack ice may contribute ca. 10–30% of the annual primary production in the Antarctic regions (Arrigo et al., 1998) and up to 57% in the central Arctic Ocean (Gosselin et al., 1997). Although landfast ice occupies only 1 to 5% of the total ice cover around Antarctica, standing crops of microalgae are three orders of magnitude greater than those reported for the multi-year pack ice autotrophic communities (Ackley and Sullivan, 1994; Archer et al., 1996; Guglielmo et al., 2000; Różańska et al., 2008).

In landfast ice, microalgae form distinct surface, interior and bottom communities that originate and develop over time under the influence of different environmental variables (e.g. Horner, 1985; Horner et al., 1992; Arrigo, 2014). Surface communities occurring at the snow–ice interface mainly result from seawater infiltration (Meguro, 1962). The internal horizons are probably the most inhospitable habitats for microalgal life, because they are constituted by columnar ice (Arrigo, 2014). Although these horizons can receive sufficient light for photosynthesis, they are characterized by brine salinities that are too high to allow microalgal growth (Arrigo and Sullivan, 1992), while the low brine volumes in the interior ice layers restrict nutrient exchange

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