TIMING OF OMEGA-3 FATTY ACID PRODUCTION IN MARINE ECOSYSTEMS: A KEY FACTOR IN A CHANGING ARCTIC

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Sea ice plays a dual role for the primary production in the high Arctic, both by providing a habitat for ice algae and by regulating the available light for primary production. As the window of opportunity for primary production becomes progressively narrowed at higher latitudes, the timing of the pulse of the essential omega-3 fatty acids, produced exclusively by marine algae, becomes increasingly imperative for all marine organisms. Through a unique field campaign at 80°N, we document how sea ice allows for two temporally distinct peaks in pulses of energy and omega-3, one in sea ice and one pelagically. These long-chained polyunsaturated fatty acids (PUFAs), play a key role in reproduction, growth and physiology for all organisms in marine ecosystems, as well as for human health. In this study we show how the herbivorous copepod Calanus glacialis, a key-species in Arctic shelf seas accounting for up to 70% of the zooplankton biomass there, is perfectly adapted to ice-covered conditions with two distinct peaks in PUFAs. Calanus glacialis optimally times its reproduction, growth and seasonal migration to the two PUFA-peaks. Our results show that females efficiently use the PUFAs available in ice algae for early reproduction, thereby enabling the first feeding stages of the new generation to take advantage of the second PUFA-peak during the phytoplankton bloom. The predicted reduced extent and thickness of the Arctic ice cap will, however, change the timing and magnitude of the current spring bloom regime, leading to a mismatch between primay production and the life-history adaptations of C. glacialis. We therefore conclude this will have a negative impact on the secondary production in Arctic shelf areas, ultimately weakening the efficient transport of metabolic energy to higher trophic levels such as fish, sea birds and marine mammals.