# Higher temperature accelerate the growth of iron-limited phytoplankton communities in the subarctic Pacific

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Iron is one of the key element determining the carrying capacity of primary production in the marine ecosystem. Because of iron scarcity in certain oceanic regions, phytoplankton communities were dominated by small-sized non-diatom species and thus less efficient trophic transfer and biological carbon pump. However, the effect of climate change such as warming on iron-limited phytoplankton is poorly investigated. This study investigated that the effect of higher temperature (+ 4–5˚C relative to controls) and iron addition on the growth dynamics of phytoplankton communities in the subarctic Pacific. Two experiments were conducted during summer in 2014 aboard R/V *Mirai* (MR14W: 47˚N, 160˚E; MR14E: 47˚N, 148˚W) and another one experiment was conducted during late winter in 2015 aboard R/V *Hakuho-Maru* (KH15: 42˚N, 146˚E). The addition of iron enhanced the specific growth rate of larger phytoplankton groups in all three experiments whereas smaller phytoplankton groups were rarely affected. In MR14W and KH15 experiments, higher temperature enhanced the growth of phytoplankton in both unamended controls and iron-added treatments. The magnitude of growth enhancement by the temperature increases was larger in smaller phytoplankton groups relative to the larger groups in the KH15 experiment. According to the relative growth rate analysis (between higher temperature (+ 4–5˚C) treatment to control temperature under each iron conditions, and between iron-added to non-iron-added treatment under each temperature conditions), we found that the summer phytoplankton communities were iron-limited rather than temperature-limited whereas late winter phytoplankton community was temperature-limited rather than iron-limited. Our results suggest that the temperature conditions could modify the dynamics of iron-limited phytoplankton communities, especially for the low-temperature conditions. In addition, future global warming may enhance the growth of phytoplankton even in the iron-limited open ocean. Given the higher temperature could enhance the growth of smaller phytoplankton groups relative to the larger ones as observed in the KH15 experiment, not only climate change but also seasonal warming from winter to summer may play a key role in the dynamics of community composition in the ocean.

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