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Remarkable structural resistance of a nanoflagellate-dominated plankton community to iron fertilization during the Southern Ocean experiment LOHAFEX

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ABSTRACT: The genesis of phytoplankton blooms and the fate of their biomass in iron-limited, high-nutrient–low-chlorophyll regions can be studied under natural conditions with ocean iron fertilization (OIF) experiments. The Indo-German OIF experiment LOHAFEX was carried out over 40 d in late summer 2009 within the cold core of a mesoscale eddy in the productive southwest Atlantic sector of the Southern Ocean. Silicate concentrations were very low, and phytoplankton biomass was dominated by autotrophic nanoflagellates (ANF) in the size range 3–10 µm. As in all previous OIF experiments, the phytoplankton responded to iron fertilization by increasing the maximum quantum yield (F_v/F_m) and cellular chlorophyll levels. Within 3 wk, chlorophyll levels tripled and ANF biomass doubled. With the exception of some diatoms and dinoflagellates, the biomass levels of all other groups of the phyto- and protozooplankton (heterotrophic nanoflagellates, dinoflagellates and ciliates) remained remarkably stable throughout the experiment both inside and outside the fertilized patch. We attribute the unusually high biomass attained and maintained by ANF to the absence of their grazers, the salps, and to constraints on protozooplankton grazers by heavy predation exerted by the large copepod stock. The resistance to change of the ecosystem structure over 38 d after fertilization, indicated by homogeneity at regional and temporal scales, suggests that it was locked into a stable, mature state that had evolved in the course of the seasonal cycle. The LOHAFEX bloom provides a case study of a resistant/robust dynamic equilibrium between auto- and heterotrophic ecosystem components resulting in low vertical flux both inside and outside the patch despite high biomass levels.

KEY WORDS: Antarctic · Protists · Fe-limitation · Si-limitation · Ecology–biogeochemistry relationship · Carbon:chlorophyll ratios · Ecosystem stability

INTRODUCTION

Pelagic ecosystem biomass inventories, i.e. the total sum of the water column standing stocks of all organisms from bacteria to top predators in units of carbon, provide the basis for assessing the trophic state of an ecosystem and its carbon sequestration potential. Information on the relative contributions of the major trophic compartments, namely phyto-, bacterio-, protozoo- and metazooplankton (Sieburth et

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