Abstract

The influence of the March 11, 2011 tsunami on the environment and the phytoplankton community in Matsushima Bay

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We studied the effects of the March 11, 2011 Great East Japan earthquake and subsequent tsunami on a large Japanese aquaculture site in Matsushima Bay, Miyagi Prefecture. To identify the influence of the tsunami, we conducted documentary searches of sewerage and environmental observation at 18 sampling sites approximately every two months from April 2012 to 2014. We analyzed the horizontal distribution of phytoplankton quantities using High Performance Liquid Chromatography (HPLC) analysis of phytoplankton pigments. In three sampling sites, where we accessed data from previous studies, phytoplankton cells were counted by microscope. We then compared phytoplankton diversity before and after the tsunami using Non metric Multidimensional Scaling (NMDS) statistical analysis.

After the tsunami, total nitrogen and phosphate discharged from the nearby Senen sewage plant in Matsushima Bay increased from 51 to 101 t/month. Total phosphate increased from 5.7 to 11 t/month. The water depth changed from -3 m to +1 m as a result of dredging and depositing caused by the tsunami. The highest Chlorophyll *a* (Chl *a*) concentration (10.4 μg/L) after the tsunami was greater than that before the tsunami (8 μg/L). However, when measured in December 2012, Chl *a* concentrations ranged from 0.4 to 10.4 μg/L and they varied among the sampling sites. Therefore, it is not clear whether the high Chl *a* concentrations after the tsunami were caused by the tsunami itself. According to the NMDS analysis, phytoplankton diversity did not differ before and after the tsunami. As Matsushima Bay is enclosed by many small islands, the influence of the tsunami might be less severe than on surrounding coastal areas and phytoplankton diversity may have been more affected elsewhere.