

# Increased stratification and decreased lower trophic level productivity in the Oyashio region - a 30-year retrospective study -

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The Oyashio Water locating along the western edge of the North Pacific subarctic circulation is one of the most productive regions of the world oceans. An analysis of the time series data sets collected from the 1960s to 1990s in the Oyashio Water revealed signs of alteration in the physical, chemical and biological properties of the water column in the western subarctic North Pacific. Wintertime salinity, phosphate concentration and apparent oxygen utilization (AOU) in the subsurface increased linearly over the 30 years. At the same time, salinity and phosphate in the surface mixed layer decreased. An increase in the density gradient in the surface and subsurface suggested that the water column stratification intensified, reducing the vertical exchange of water properties during the period. The Net Community Production (NCP), estimated from the phosphate consumption from February through August, also declined. Water column Chl a was approximately halved and diatoms decreased by one order of magnitude in spring, consistent with the multi-decadal decreasing trend of NCP. Zooplankton biomass was also nearly halved during the same period. In contrast, wintertime Chl a increased by 63% and diatom abundance doubled. Developmental timing became earlier in *Neocalanus flemingeri*, and spring occurrence of *N. plumchrus* increased after the 1980s. Reduced vertical water exchange might have limited nutrient supply to the level, decreasing winter-summer NCP for these three decades. It is speculated that, in the meantime, the earlier stabilization of the surface layer might have enhanced wintertime diatom production in the Oyashio's light-limited environment. This condition could allow zooplankton to effectively utilize diatoms from earlier timing, resulting in the apparent early developmental timing and abundance increase.