



## Nitrate : phosphate ratios and *Emiliana huxleyi* blooms

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**ABSTRACT:** It has been hypothesized that phosphate limitation, classically indicated by  $\text{NO}_3 : \text{PO}_4$  ratios  $>16$ , is one of the critical factors allowing the coccolithophorid *Emiliana huxleyi* to bloom. This hypothesis is based on physiological studies showing that *E. huxleyi* has an exceptionally high affinity for orthophosphate and is able to use organic phosphate. Indeed, *E. huxleyi* has been found to bloom at high  $\text{NO}_3 : \text{PO}_4$  ratios in some mesocosm studies and in the oceanic northeast North Atlantic. Recent *E. huxleyi* blooms on the southeastern Bering Sea shelf, however, occurred under low  $\text{NO}_3 : \text{PO}_4$  conditions, which is indicative of nitrogen rather than phosphorus stress. A review of field studies of blooms where nitrate and phosphate were measured indicates that  $\text{NO}_3 : \text{PO}_4$  was in fact frequently low. A survey of most of the areas of the world ocean where satellite-detected *E. huxleyi* blooms occur also shows that  $\text{NO}_3 : \text{PO}_4$  ratios are generally low. These observations suggest that *E. huxleyi* is able to exploit situations where either phosphorus or nitrogen is limiting to competing species. They also indicate that attention should be directed to examining organic nitrogen, organic phosphorus, and ammonium during *E. huxleyi* blooms to better understand the role macronutrients play in these blooms.

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