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TITLE: Nitrogen as the limiting nutrient for eutrophication in coastal marine ecosystems: Evolving views over three decades

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ABSTRACT:

The first special volume of Limnology and Oceanography, published in 1972, focused on whether phosphorus (P) or carbon (C) is the major agent causing eutrophication in aquatic ecosystems. Only slight mention was made that estuaries may behave differently from lakes and that nitrogen (N) may cause eutrophication in estuaries. In the following decade, an understanding of eutrophication in estuaries proceeded in relative isolation from the community of scientists studying lakes. National water quality policy in the United States was directed almost solely toward P control for both lakes and estuaries, and similarly, European nations tended to focus on P control in lakes. Although bioassay data indicated N control of eutrophication in estuaries as early as the 1970s, this body of knowledge was treated with skepticism by many freshwater scientists and water?quality managers, because bioassay data in lakes often did not properly indicate the importance of P relative to C in those ecosystems. Hence, the bioassay data in estuaries had little influence on water?quality management. Over the past two decades, a strong consensus has evolved among the scientific community that N is the primary cause of eutrophication in many coastal ecosystems. The development of this consensus was based in part on data from whole?ecosystem studies and on a growing body of evidence that presented convincing mechanistic reasons why the controls of eutrophication in lakes and coastal marine ecosystems may differ. Even though N is probably the major cause of eutrophication in most coastal systems in the temperate zone, optimal management of coastal eutrophication suggests controlling both N and P, in part because P can limit primary production in some systems. In addition, excess P in estuaries can interact with the availability of N and silica (Si) to adversely affect ecological structure. Reduction of P to upstream freshwater ecosystems can also benefit coastal marine ecosystems through mechanisms such as increased Si fluxes.

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