LETTER

Coastal marine eutrophication: Control of both nitrogen and phosphorus is necessary

Whole-lake experiments by Schindler and others since 1971 have conclusively shown that phosphorus is the major cause of eutrophication in freshwater lakes (1). In response, in the 1970s governments began to reduce phosphorus inputs, and water quality in many lakes improved dramatically. However, eutrophication has increased in many coastal marine ecosystems since the 1970s, including the Chesapeake Bay, Long Island Sound, and the Gulf of Mexico "Dead Zone." Why? Nitrogen contributes to eutrophication in these ecosystems, and nitrogen pollution has grown tremendously since the 1970s (2, 3).

Unfortunately, Schindler *et al*. (1) generalize their lake results to estuarine and coastal ecosystems, suggesting that the controls on eutrophication in lakes and coastal waters are the same. If this is true, reducing nitrogen in coastal systems could cause blooms of nitrogen-fixing cyanobacteria, as occurs in many lakes. Substantial research over 2 decades demonstrates that this premise is wrong, and in most estuaries and coastal waters worldwide with salinities exceeding 6–8‰, planktonic, nitrogen-fixing cyanobacteria do not occur because their growth is controlled by factors other than phosphorus supply (2–4). At least 1 of these other controls (grazing) apparently is relaxed in offshore waters such as the Mid-Pacific Gyre in which *Trichodesmium* fixes significant quantities of nitrogen. But the nitrogen fixers are missing from most estuaries and coastal seas.

For decades, governments relied on phosphorus controls alone to solve coastal eutrophication. That experiment failed, and a strong consensus of estuarine and coastal scientists has for more than a decade stated the need to control both nitrogen and phosphorus (2, 3, 5).

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Author contributions: R.H. and H.W.P. wrote the paper.

The authors declare no conflict of interest.

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