Fertilizers and eutrophication in southwestern Australia: Setting the scene

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Abstract

An excess of plant nutrients has caused serious eutrophication in aquatic ecosystems of southwestern Australia manifested by excessive growth and accumulation of green and bluegreen algae. Phosphorus is generally the limiting nutrient for algal growth and phosphatic fertilizers applied to nutrient-deficient, leaching, sandy soils are the main source of P, supplemented by rural industry point sources. Nitrogen is the limiting nutrient in marine embayments with little drainage from the land. Measures to reduce the load of P delivered to drainage include basing fertilizer application rates on soil testing for P and the use of less soluble P fertilizers. Catchment management plans are being implemented with community involvement to reduce P loads and maintain agricultural production. This introductory paper reviews the history of eutrophication in southwestern Australia and of studies into its causes, principally in the large Peel-Harvey estuary. It briefly summarises other papers in this special issue concerned with different aspects of the problem: how to fertilize the land without causing eutrophication.

Introduction

Symptoms of eutrophication – the proliferation of algae – are increasingly evident in lakes, estuaries and other coastal waters in the south west of Western Australia (Fig. 1) and phosphorus has been shown to be the limiting nutrient for algal growth in almost every case where it has been investigated. Phosphatic fertilizers are the principal nutrient source, together with wastes from intensive agricultural industries in more closely settled areas. Routine application of superphosphate to nutrient-deficient soils at relatively high rates has led to the accumulation of P stores in excess of pasture needs. Much P is lost to drainage from leaching sandy soils, both from this store and from fertilizer applied in the current year. We have the dual problem of how to manage the land to maintain optimal production while not promoting excessive growth of algae in lakes and estuaries – how to fertilize the land without causing eutrophication?

Estuaries are the principal natural inland waters of the south west and this special issue of ‘Fertilizer Research’ concentrates mainly on studies related to nutrient enrichment in the large Peel-Harvey estuarine system (Fig. 2); it reviews scattered material published in journals and in local reports not readily available overseas, with some unpublished research, and assesses the present position.

By 1970 it was evident that the Peel-Harvey estuary was seriously eutrophic: a mat of the green alga Cladophora covered the bottom of Peel Inlet and washed up on the beaches, where hydrogen sulphide from the rotting algae distressed local residents who demanded action to abate the nuisance. Bulldozing rotting algae from the shores near housing only partially
ameliorated the algal nuisance; it was costly, damaged the shoreline vegetation, and offered no prospect for a permanent solution. The condition of the estuary deteriorated progressively and from 1978 massive blooms of the blue-green alga *Nodularia* (Cyanobacteria) coated the surface of the water in spring and early summer and produced nauseating odours. Collapse of these blooms caused anoxic conditions, release of phosphate from the nutrient-rich sediments, and the death of benthic invertebrates and sometimes of fish.

Estuaries are a focus for urban development, for recreation, and for commercial and recreational fishing. Perth, the capital of Western Australia, surrounds the estuary of the Swan River and for many years massive accumulations of green algae fouled estuary beaches and had to be collected and carted away. This 'algal pollution' was blamed on the discharge of sewage effluent into the estuary, but it continued long after the offending sewage farm was closed [9]. The estuary is still nutrient enriched, from urban and agricultural sources, but phytoplankton now replace macroalgae as the principal symptom of eutrophication.

Other estuaries and many lakes are now eutrophic and, as in Peel-Harvey, P is generally the limiting nutrient for algal growth and agricultural fertilizers applied to sandy soils are still the major source, although point sources such as piggeries now make an increasing contribution. Some marine embayments also are eutrophic, caused by fertilizer P, but N is the limiting