

Scaling the potential for eutrophication and ecosystem state in lagoons



"Empirical relationships are found for catchment runoff and efficiency of nitrogen-load delivery to lagoons in New South Wales, Australia. Empirical results and analysis of biogeochemical mechanisms are used to estimate the potential for eutrophication and changes in ecological state that result from increased total nitrogen export from a catchment to a lagoon. The link between empirical results and results from a complex biogeochemical model is illustrated by analysing an analytical model of intermediate complexity. Excluding conditions under which there is a change of ecological state, key features of complex biogeochemical models are argued to depend more upon source and sink terms than upon the many complex mechanisms that conservatively transform nitrogen from one form to the other. In lagoons the relative role of flushing and biogeochemical sinks/sources depends upon a flushing speed scale defined as mean depth divided by the flushing time scale. The potential for eutrophication is introduced as a more practical metric for ecosystem management than eutrophication. Potential for eutrophication and the light extinction coefficient scale according to the square root of effective total nitrogen load per waterway area. Such scaling relationships, and hypsometry, can be used to estimate coverage of lagoons with benthic macrophytes and how sensitive this coverage is to the effective total nitrogen load per unit area of waterway. Calculations show hypsometry to be a strong constraint on ecosystem function."

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