A dying shame – Australian coastal freshwater lakes

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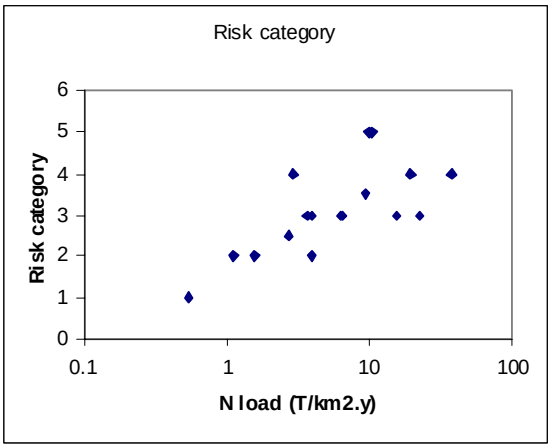
The Gippsland Lakes are the largest of a number of coastal freshwater lakes (or lagoons) that lie along the east coast of Australia from Tasmania to the central NSW coast. These beautiful lakes are the home of many rare and endangered species and contain many valuable ecological assets from seagrass beds to breeding sites for fish and birds. All are separated from the sea by a barrier of sand dunes and would originally have opened to the sea intermittently when rainfall caused lake levels to rise and a flush of water to break through the dunes. Understandably people wish to live or spend their weekends beside or close to these places. Unfortunately the rapid spread of tourism and coastal development along the coast means that they are now subject to many pressures. These coastal lakes are suffering from land use change and forest clearing in their catchments, suburban development, alteration of freshwater inflows, storm and waste water discharges, over fishing and resource development of various kinds. In addition, because they make excellent harbours for small craft along an otherwise exposed coastline (and local residents found the occasional changes in lake level inconvenient), many of the lakes have been opened to the sea, and some are now permanently dredged at their mouths.

The consequences of these actions are lakes that now suffer habitat loss, salt ingress and the destruction of freshwater wetlands, increased nutrient loadings, overfishing and various kinds of pollution. The Gippsland Lakes have all these problems and more. Salt ingress since the permanent opening of Lakes Entrance in the 1880s has caused long term changes in the Lakes which are still going on. Reduced freshwater inflows (through the construction of dams in the catchments and the use of freshwater for irrigation and cooling in power plants) has made the salt ingress worse. The main Lakes are now frequently stratified – with warmer freshwater at the surface lying over a zone of colder, denser, salty water lower down. Salt water is eating away at

freshwater wetlands and, by killing off the freshwater plants in Lake Wellington during the 1967 drought, has led to the replacement of clear, fresh water and aquatic flowering plants with turbid, brackish water and toxic cyanobacterial (blue-green algal) blooms. Excessive nutrient loads from agricultural and urban development in the catchments increases the frequency of these blooms. Increased plant production in the water column (and algal blooms at the surface) leads to decomposition in the now stratified waters and the reduction in oxygen concentrations in bottom waters. Deoxygenation and anaerobic conditions in bottom waters hampers the ability of the Lakes to deal with nutrient inflows and, indeed, the Gippsland Lakes export anaerobic decomposition products (ammonia) to the ocean on the falling tide. If this were not enough the Gippsland Lakes suffer from other problems associated with air pollution from the nearby power plants of the LaTrobe Valley and from oil and gas extraction offshore. A combination of tectonic adjustment and extraction of oil, gas and water from below the sea bed offshore means that the Lakes are subsiding. Storm surges have a greater impact as the land subsides.

The problems experienced by the Gippsland Lakes have parallels in most of the coastal lakes along the east coast. All are showing some kind of human impact. Those lakes that are in protected and forested catchments are in much better condition than those in agricultural or urban catchments. It is slowly dawning on people that land management actions all the way back to the tops of the hills surrounding the lakes have an impact on the water quality and ecological values of the lakes. Each and every resident of the contributing catchments – even those living a long way back from the coast – can work to improve the condition of the lakes by limiting nutrient runoff and the disposal of pollutants. Work has been going on in catchments surrounding the



This is a plot of "risk category" for coastal lakes (where each point is a different lake up the East Coast) against the annual Nitrogen loading to the lake from the catchment (expressed as the annual load in tonnes N per square km of lake surface per year – normalised for Lake area therefore). In the "risk category" 1 is pristine (clear water, Seagrasses etc). 5 is degraded (turbid with frequent toxic algal blooms). Data collected by GH and also from a paper by Scanes et al.

Wallis and Myall Lakes on the Central NSW coast to improve the condition of stream bank (riparian) vegetation to control and reduce nutrient loads to these lakes. Myall Lakes have been experiencing frequent toxic algal blooms in recent years.

Seagrass beds are probably the most valuable ecological assets in the lakes because of their importance in promoting the breeding of fish and their beneficial nutrient cycling processes. Most seagrasses will only grow well in clear water. Research over the last decade in a number of these lakes has provided good information about the relationship between increased nutrient loads to the lakes and seagrass loss. Increased nutrient loads (principally nitrogen loads) lead to increased frequencies of algal blooms in the water, increased water turbidity and the growth of algae on the leaves of the seagrasses themselves – all of which contribute to shading, reduced photosynthetic

performance and the death of the seagrass beds. As it turns out, once this happens and decomposition of the algal blooms becomes the dominant process in the lakes, it is very difficult to get the seagrasses to recover because changes in the sediments and the way they process nutrients act as a positive feedback and you get a continual cycle of algal blooms. We have learned that one of the most sensitive indicator of a lake in trouble is the nature and magnitude of the nutrient cycling processes in the sediments of the lake. Not an obvious measure, but a key one nonetheless; and one which provides warning of undesirable change to come. So the lakes can exist in two forms – either clear and seagrass dominated with beneficial sediment nutrient cycling processes, or turbid and algal bloom dominated with extensive oxygen depletion and rapid decomposition in the sediments. Once the lake is flipped out of the seagrass dominated state to the algal bloom dominated state it is very difficult, if not impossible, to get it to go back. In most cases the nitrogen load required to make the lake flip back is so very low that it is practically impossible to achieve without total reforestation of the catchment – no longer a viable management option in most cases.

When we increase nutrient loads to these lakes through catchment development and alter the hydrological balance by controlling freshwater inflows and opening entrances we inevitably alter their ecology. The lakes are as sensitive to hydrological disturbance as they are to increased nutrient loads. It is actually possible to get a simple (but effective) visual assessment of the condition of these coastal lakes by walking the beaches and looking into the water from a small boat. Every one of us can become a guardian of these lakes. Clear water, abundant seagrasses free from algal growths on their leaves and few algal blooms either in the water or washed up on the beaches are good. Turbid water, algal and seaweed blooms and either overgrown seagrasses or no seagrasses at all are bad. It turns out that there are some simple relationships between nutrient loads and changes in ecosystem structure that can be used to guide management. There are some “rules of thumb” we can use in the form of estimates of “critical nutrient loads” – below which environmental damage is almost certainly prevented. Local councils and State agencies are using such rules to control nutrient loads and to assist with the management of these valuable, and beautiful, parts of our coasts.

Reference

Scanes P, Coade G, Large D and Roach T 1998, Developing criteria for acceptable loads of nutrients from catchments. p. 89-99 in Proceedings of the Coastal Nutrients Workshop, Sydney, (Oct. 1997), Australian Water and Wastewater Association, Artarmon, Sydney.