Algal growth and the phosphorus cycle

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Large algal and microscopic phytoplankton foul the waters of the Peel-Harvey estuarine system, upsetting the fishery and polluting the beaches. These aquatic plants grow in response to phosphorus runoff from drainage, trapping phosphorus in the estuary and using it in their growth. When they die this phosphorus remains in the system to be recycled for further plant growth. Algal pollution in the estuary can be lessened by reducing the amount of phosphorus entering the system, increasing phosphorus losses to the ocean, or in some way blocking the trapping and recycling processes.

Macrolagae
The most prominent of the macroalgae are the ball-forming green alga Cladophora ('goat weed'), the paler-green Enteromorpha, and the hair-like Chaetomorpha. These algae were not prominent in the estuarine system until the mid 1960s when massive accumulations of goat weed appeared on the beaches of Peel Inlet. Since then the amounts and type of algae have varied, with an estimated maximum of 70,000 tonnes in the estuary in 1979.

Seagrasses
Seagrasses are not algae but resemble the conventional grasses. They live submerged in the shallower waters of the estuary where they are grazed by swans and ducks. Seagrasses are important in food chains and are ecologically more desirable than macroalgae. Seagrasses have been smothered by masses of macroalgae in some areas. They are much more prominent in Peel Inlet than in Harvey Estuary, where wind-stirring of the sediments greatly reduces the amount of light penetrating to the estuary floor. Seagrass leaves which accumulate on the shores in some seasons do not rot as offensively as do the macroalgae.

Phytoplankton
Phytoplankton are microscopic organisms suspended in the water. Under calm conditions some tend to sink, others to float; all are readily stirred into the water by wind. Two groups are particularly important in the Peel-Harvey estuary.

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Phytoplankton as seen under a microscope and (inset) Nodularia filaments.

(Figure 1). If phosphorus were to be stopped from entering the system in a particular winter, there should be a smaller Nodularia bloom the following summer.

Research shows that although enough phosphorus has accumulated in the top few centimetres of the sediment to sustain Nodularia growth for a time, a significant reduction in the amount of phosphorus entering the estuary would greatly reduce Nodularia blooms in the relatively short term. But stopping the application of phosphorus to paddocks in the Harvey catchment would be followed by an unknown period of run-down as accumulated phosphorus is leached from the soil into the estuary, rather than a sudden significant reduction. Thus the rate of recovery of the estuary would be limited by the rate of run-down from the catchment.

**Trapping phosphorus in the system**

Diatoms and other microscopic organisms trap and use phosphorus entering the water in winter in their growth. When they die they become a part of the sediment, and help to build up the phosphorus ‘bank’ to fuel Nodularia blooms in summer.

Once the Nodularia starts to bloom, less oxygen is available at the floor of the estuary and this enhances the release of more phosphate from the sediment.

The macroalgae grow in summer when the water is warmer and there is more light penetration, but at this time nutrient levels in the water are low. The algae build up a layer on the floor of the estuary. Only the algae at the surface of this bed receive enough light to grow; at the base there is a rotting mass releasing nutrients to the living layer above.

During the past few years the amount of macroalgae in Peel Inlet has fallen substantially. Less light is reaching the floor of the estuary in summer because of the increased growth of blue-green algae and other phytoplankton.

**The future**

A reduction in phosphorus accumulation—that is, an increase in the rate of loss of phosphorus to the ocean as well as a reduction in the amount of phosphorus entering the estuarine system from the catchments—will immediately lessen the severity of blue-green algal blooms. In the Harvey Estuary this will probably lead to a small increase in the amount of seagrasses and macroalgae.

In Peel Inlet smaller phytoplankton blooms will lead to better light penetration to the floor of the estuary, and a consequent increase in the amount of macroalgae, which will continue to be mechanically harvested. At a later stage, a reduction in the amount of nutrients entering the Peel Inlet will lead to less macroalgae and relatively more seagrasses.