

Sediment pollutants

Background

There are a number of pollutants that affect the water quality and ecological health of estuaries. Many pollutants build up in sediments and can be measured. Pollutants commonly found in estuaries include organic matter, metals, and organic chemical pollutants. These pollutants:

- are generally discharged to estuaries with stormwater runoff from the land. Organic matter is also produced in estuaries by the decay of plant material
- accumulate in estuary sediments, which can preserve a record of estuary pollution
- are measured with sophisticated scientific instruments that are available in testing laboratories.

In this section we briefly describe some of these pollutants and their potential effects in estuaries. After reading this section, you may suspect that some of these pollutants could be an issue for the health of your estuary. If your samples are correctly taken and stored, they can be analysed at a later date in a testing laboratory. Guidelines for collecting and storing sediment samples are provided in the "**Collecting sediment samples**" section of this module.

Organic matter content

Organic matter accumulates in estuaries and can influence sediment quality. High amounts of organic matter (OM) in sediments indicate that sources within the estuary are nearby (e.g., saltmarsh, mangroves, algal mats) and/or there are large inputs from the land. Catchment sources of OM include forests and sewage. Typically, the OM content of estuary sediments is 1–5% of the dry sediment weight. High OM content commonly leads to low dissolved oxygen levels and higher levels of sulphides in sediment. This is because some types of bacteria need oxygen to break down organic material in sediments and, in doing so, they deplete dissolved oxygen levels (these are known as aerobic bacteria). The OM content of sediments also influences the toxicity of metals and other contaminants. Higher OM content generally reduces the availability and toxicity of other pollutants (e.g., metals) to plants and animals. High OM levels can indicate that your estuary is poorly flushed by the exchange of tidal waters. This can occur in side arms and bays, and in estuaries where the entrance is temporarily closed by sand and/or gravel deposited by waves and currents.

The organic matter content of sediments is commonly measured by burning a small sediment sample in a very hot furnace and weighing it before and after combustion using highly accurate scientific scales. This method is commonly referred to Loss on Ignition, or LOI for short.

Metals

Metals are washed into estuaries with sediments, particularly during storms. Sources of metals include volcanic soils and stormwater runoff from roads, towns, and cities. Metals that commonly occur at elevated levels in New Zealand estuaries include arsenic, zinc, copper, lead, chromium, and mercury. Each of these metals has natural and human sources. For example, high zinc and copper concentrations often indicate stormwater runoff from busy roads. This is also the case for lead, although levels of lead in estuary sediments have been declining since the 1980s when lead was no longer added to petrol. Arsenic and chromium are leached from wood preservatives, as well as natural sources in some types of rock. Mercury is often found in landfill waste or old boat yards.

Metals tend to stick or bind to silt and clay particles, and accumulate in areas with slow currents where these particles can settle out of the water. These conditions occur on intertidal flats in the upper reaches of estuaries, saltmarshes, and mangrove forests. Sediment-bound metals can, under certain conditions (related to temperature, pH, and dissolved oxygen), be released back into the water and be taken up by plants and animals. Measuring the metal concentrations in sediments and animals is a very reliable indicator of estuarine health.

Because metal concentrations in sediments reflect environmental pollution levels at any particular time, estuary sediments preserve records of the pollution history of estuaries. Scientists collect sediment cores to measure how metal concentrations have changed over time, particularly after catchments become urbanised and the runoff of metals such as zinc and copper increases. Also, because sediments are deposited layer by layer, year by year, the age of sediments increases with depth below the sediment surface. Therefore, by sampling sediments at different depths and measuring metal concentrations, the historical increases in estuary pollution can be reconstructed. The age of sediments at each depth can also be measured using dating methods. By dating the sediment cores, scientists can work out when major increases in pollution levels occurred; such changes often coincide with major changes in the catchment.

To correctly interpret these metal pollutant records preserved in sediment cores, scientists also measure the particle size of sediments. This is because the amount of metals attached to sediments depends on the sediment particle size. Typically, most of the metals in a sediment sample are attached to the smallest clay and silt particles rather than the larger sand particles. In some cases, metal concentrations at a site can be higher because the sediments have become more muddy and not because of any actual increase in environmental pollution. Therefore, the particle size is an important measurement. This will require the services of a testing laboratory. It is important to use the same particle size method each time so that you are comparing like with like. If you are interested in monitoring metal pollution in your estuary, you should contact a suitable accredited testing laboratory to discuss your options ("**Collecting sediment samples**" section).

Hydrocarbons and other organic chemical pollutants

Estuaries also trap other pollutants that are produced by industrial and farming activities, by vehicles, and also by products that you may use around your home. These pollutants include petrol (petroleum hydrocarbons), pesticides, and their residues. Like metals, these pollutants are delivered to estuaries with sediments, particularly during storms, and accumulate in estuary sediments.

Some of these organic pollutants may degrade into other forms. An example of such a pollutant is the pesticide DDT (dichloro-diphenyl-trichloroethane), which was used in New Zealand from 1950 to 1970 to control grass grubs in pasture. The use of DDT was banned in New Zealand because it accumulates in the tissues and is toxic to human beings and other animals. Another example of a family of organic pollutants that accumulate in urban estuaries are PAHs (polycyclic aromatic hydrocarbons), which are found in tar and are also generated by burning fossil fuels, such as petrol and coal. In high enough concentrations, these pollutants are of concern because some types of PAH can increase the risk of cancers and birth defects.

The levels of organic pollutants in your estuary will depend on the activities that have occurred in the catchment. Many of these pollutants have resulted from activities that have occurred since the 1940s. Gathering information about the history of your area will give you some idea of the likely risk of organic pollution in your estuary. Regional councils, libraries, and newspapers, as well as your kuia and kaumātua, will be good sources of historical information.

Indicators of organic pollution include the appearance and smell of the sediment, e.g., an oily sheen on the water surface or sediments and/or a strong smell like mothballs. The analysis of specific organic pollutants in water and sediments is complex and requires the services of testing laboratories. If you are interested in monitoring organic chemical pollution in your estuary, you should contact a suitable accredited testing laboratory to discuss your options.

Guidelines for storing and analysing sediments to measure pollution

In this section we describe guidelines for storing samples and analysing chemical pollutants in estuary sediments. Be sure to read the safety information in the **About this Toolkit module** before sampling sediments in your estuary. Methods for sampling surface samples and sediment cores are described in the "**Collecting sediment samples**" section of this module.

- Store your samples in a fridge or chilly bin after collection. If you do not want to analyse your sediment samples immediately (i.e., within one week of collection), then the samples should be frozen. If you are interested in organic matter content, you will need to freeze your sediment samples immediately after collection to stop the organic matter decaying.
- If you are working in an estuary where there are no apparent sources of pollution, you may wish to collect surface sediment samples as part of your baseline survey (see **About this Toolkit module**). These samples can be analysed by a testing laboratory to give you baseline levels of pollutants in your estuary; or the samples could be frozen and analysed at a later date. Major land-use changes (e.g., from bush or farmland to towns), road construction, industrial development, and accidental spillages are potential sources of metal and organic chemical pollution.
- Use the services of a testing laboratory to measure sediment pollutants and particle size, but make sure the laboratory is registered with IANZ (International Accreditation New Zealand). This means that your samples will be analysed using scientifically accepted methods. The IANZ website provides a search tool for you to find your nearest registered testing laboratory (<http://cabis.ianz.govt.nz/ianzwebportal/>). Search the website by keyword "Environmental" to list suitable registered testing laboratories. Your regional council will also be able to provide advice on analysis of sediment samples for pollutants.
- If you are working in an estuary that is likely to have been polluted over many years, you may wish to reconstruct the pollution history of your estuary by collecting sediment cores using plastic pipes (see "**Collecting sediment samples**" section).