

Sedimentation

Objective

To measure sedimentation accumulation rates (SAR) at estuary monitoring sites using buried plates.

Background

Sedimentation is the process by which sediments are deposited. This could be sand grains falling out of the air to form a sand dune or mud settling out of storm water to form mudflats in an estuary.

Sedimentation is the main process that forms estuary habitats, such as intertidal flats, and is also a key driver of how rapidly habitats change. This sedimentation process becomes increasingly important on intertidal flats because many plants and animals are sensitive to the length of time that they are exposed to the air or submerged during each tidal cycle. As the height of the intertidal flat increases due to sedimentation, plants and animals spend less time underwater during the high tide period. This results in changes in the communities of plants and animals that can live in your estuary. For example, mangroves and saltmarsh only establish on intertidal flats above the **mean sea level** (halfway between low and high tide). So sedimentation has an important control on plant establishment, distribution (location) and resulting habitat changes in estuaries. Over time, the mix of habitats and their relative sizes will change as your estuary fills with sediment.

In this section we describe how to use sedimentation plates, an easy-to-use and very accurate method to measure sedimentation rates in your estuary. Sedimentation plates are usually made from tiles that are buried below the sediment surface. They provide a stable horizontal surface from which changes in the surface level of the sea bed (due to sedimentation or erosion) can be measured. Changes in the thickness of the sediment deposit on the plate indicate the amount/rate of sedimentation during the time period between surveys.

Where to monitor

Deciding where to install sedimentation plates depends on the objectives of your monitoring. Some options include:

- in each of your estuary's main habitats
- at sites where habitat change may occur in the future
- along a transect set up to monitor plants and animals

- along a transect from low to high tide
- along a transect moving away from a sediment source, such as a stream mouth.

Try to pick sites that are representative of the habitat you wish to measure. For example, if you wish to measure sedimentation on a sandflat, do this well away from tidal channels, where conditions may be different to the rest of the sandflats. This is called an **edge effect**. You may, in fact, want to monitor the edge effect at the boundaries between habitats, but you need to be aware of what it is you are measuring. Also, pick sites that are not likely to be disturbed by people.

Before installing sedimentation plates and marker pegs, check whether you need consent from your regional council.

How often and when to monitor

In most New Zealand estuaries, **sediment accumulation rates** (SAR) are usually less than 5 mm/year. However, SAR can occur more rapidly in saltmarsh, mangroves and tidal creeks near stream outlets. In these habitats, SAR can be 20 mm/year or more.

Measure your sedimentation plates at least once each year and at the same time of year. Summer is a convenient time to do this.

Because most sediment is delivered to estuaries during large storms, it is useful to make 'after-storm' measurements. Large storms that may occur only once every few years can result in very obvious changes in your estuary, with old mud banks and sand banks near channels eroded, and new ones deposited elsewhere. Fresh storm deposits are usually bright yellow/orange, while estuary sediments are usually dull brown or grey. These colour differences can give you a good idea of where sedimentation has occurred during a storm.

Summary of method

Install a sedimentation plate and marker pegs. Use sedimentation plates to monitor SAR in your estuary based on measurements of the depth of the plate below the sediment surface.

Links to other methods and modules

- Habitat module
- Plant module
- Shellfish module
- Fish module

Equipment needed

You will need the following items:

- sedimentation plates. The best option is to use ceramic tiles. These can be sourced from tile and hardware shops, which often have cheaper end-of line stock. 30 cm x 30 cm x 1 cm thick ceramic tiles are best because they are light and strong. Although you could use other materials for plates (such as concrete, plywood or steel).
- marker pegs x 2 (0.5 m long) to locate the site. If using wood stakes, make sure these are tanalised so that they do not rot. Plastic pipe, about two centimetres in diameter, is a long-lasting alternative. This is a good option if the site is in an area used by boats at high tide, as it's less likely to damage boats or cause injury. Plastic pipe is available from electrical and hardware stores
- measuring rods x 12 (40 cm long and 3–4 mm thick). You can use dowelling or knitting needles. However, if you're wanting to measure more than one sediment plate during your field visit we recommend using plastic or metal rods that can be wiped clean between each sediment plate. Also as far as possible, make sure that all your measuring rods are exactly the same length.
- spade and 5 m tape measure
- GPS or magnetic compass to locate site
- 30 cm ruler marked in mm intervals. Use a ruler that has the zero mark at the edge of the ruler
- camera, clipboard, pencils
- Old rag. To wipe clean your measuring rods.
- datasheet: "Sedimentation plate".


Data collection and management

Enter the data collected into the "Sedimentation plate" datasheet. Use a new datasheet for each sedimentation plate.


How to: Install a sedimentation plate

- 1 Dig a square hole the same size as the sedimentation plate and at least 10 cm deep. Place the sediment in a pile at least two metres away from the hole. You will use this sediment to bury the plate. Check the depth with a ruler or tape measure. Make sure the bottom of the hole is flat and as level as possible.
- 2 Place the sedimentation plate in the bottom of the hole. Make sure it is as level as possible.




-  To install a sedimentation plate, dig a hole the same size and shape as the plate and at least 10 cm deep. Check the depth of the hole using a tape measure or ruler.



-  Carefully place the plate in the hole and make sure it is as level as possible.

- 3 Install two marker pegs on opposite sides of the plate each at exactly the same distance from the edge of the hole. We recommend a distance of between one and two metres. Push the marker peg into the sediment, leaving about 15 cm showing above the surface.



-  Install a peg either side of the sedimentation plate at exactly the same distance so that you can relocate it when you return to make measurements.

- 4 Using the sedimentation installation field datasheet draw the layout of the site showing the positions of the plate, marker pegs and the distances between them.
- 5 Record the location of both marker pegs using a GPS. If you are using a magnetic compass, record the position of one marker peg and record the distance and bearing to the other peg. This information can be used to re-locate the buried plate if the pegs are buried or removed.
- 6 Also record the initial depth of the plate and the size of your sedimentation plate (e.g., 30 cm x 30 cm) on the sedimentation installation field datasheet
- 7 Bury the plate using the sediment originally dug from the hole making sure to fill the hole to the same level as the surrounding sediment.
- 8 Wait at least one month to let the site return to a natural state before coming back to make your first (**baseline**) measurements, using the "How to: Measure sedimentation using a sedimentation plate" method that follows.




Cover the plate with the sediment that you originally dug from the hole and fill to the same level as the surrounding sediment.

How to: Measure sedimentation using a sedimentation plate

When returning to the site make sure to approach the site carefully to avoid walking over the buried sedimentation plate. You can use the marker pegs as a guide for the location of the buried plate. If you do accidentally disturb the plate, you will need to re-install the plate and start your measurements over again. As far as possible, the same people should always make the measurements. This reduces differences in measurements that occur because of the way the observer makes the measurements

- 1 Locate your two marker pegs and lay the tape measure between them.
- 2 Locate the edges of the sedimentation plate, using your installation diagram.
- 3 Once you have located the plate, be sure not to stand on it.
- 4 Push the measuring rods straight down (vertically) into the sediment until they hit the buried plate. It is important to make sure the rods are pushed into the sediment as close to vertical as possible. You can arrange the measuring rods in a regular pattern, equally spaced, or at random, across the plate.
- 5 If you notice that one of the measuring rods can be pushed down significantly further than the other rods, you may have missed the plate. Remember that your sedimentation plate will generally be 30 cm x 30 cm, but refer to your sedimentation installation field datasheet for the exact size of your plate.



-  To make your measurements of the sediment thickness, push the rods straight down until they hit the buried plate.

- 6 The sediment thickness above your plates can vary due to bed ripples and the activities of animals, such as burrowing crabs that leave mounds of sediment on the surface. We recommend that you make a minimum of 12 measurements of the sediment thickness over the plate. By making 12 measurements you get a much more accurate estimate of the sediment thickness than one based on only one or two measurements.
- 7 Pull each measuring rod out of the sediment one at a time, and as accurately as possible measure the distance from the bottom of the rod to the mark left on the rod by the sediment layer (in mm). Record each value on the "Sediment plate measurement" datasheet.
- 8 If you intend to make more than 12 measurements at a site or measure more than one sediment plate during your field visit, you will need to wipe your measuring rods clean before repeating step 3-7.
- 9 After making your measurements be sure to leave the site the same way you entered it.

Data analysis

The baseline measurements will be used to monitor future changes in the sediment level and, thereby, determine sedimentation rates at each of your sites.

For each set of measurements you should calculate the average, standard deviation and standard error for the sediment thickness above the plate to the nearest 1/10 mm.