Estuary monitoring by communities

Mangrove habitats a case study

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Introduction

These guidelines outline a recommended minimum set of methods for a community group interested in following habitat changes in an estuary. They have been developed in relation to mangroves but the principles can be applied to a number of aspects of estuarine ecology in general. They are designed primarily to: *provide guidance in planning a simple monitoring programme enabling community groups to increase understanding of mangrove habitat in their local estuary*.
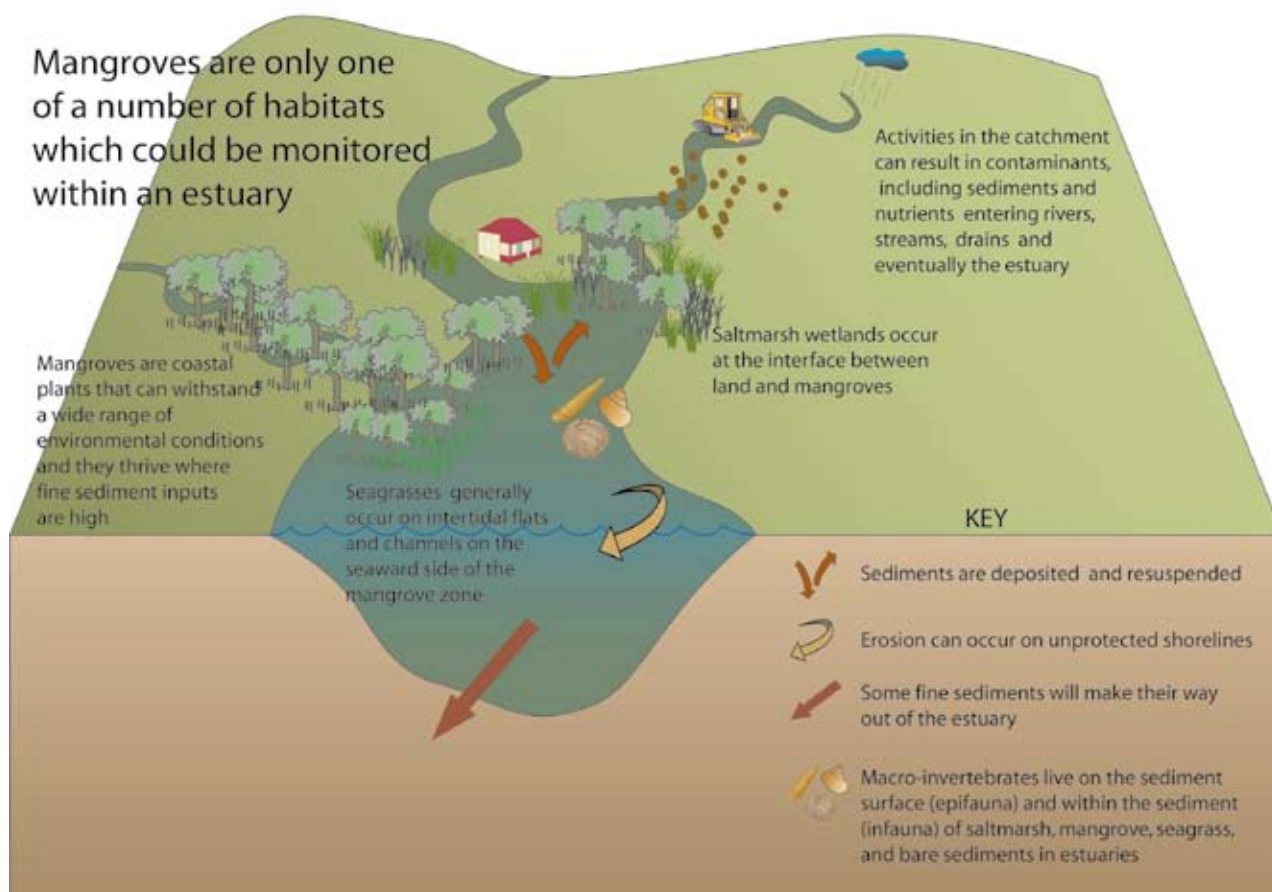
In this context 'monitoring' is used to mean taking a standard set of measurements at regular intervals and keeping a record of results so they can be compared over time.

These guidelines are based on the document "*Some options for community-focused ecological monitoring of mangrove habitats in estuaries*" compiled by the scientific working party of the Mangrove Steering Group (Environment Waikato). Interested parties are referred to that document for more detail regarding monitoring of consented activities.

The methods have been developed in conjunction with a community group field trial (Waikaraka Estuary Managers). Further modifications may be required for your particular estuary, and there are a number of components that could be added. For example, subsequent to this trial the Waikaraka Estuary Managers have included birds in the monitoring programme. Methods were developed in discussion with Environment Bay of Plenty, Department of Conservation, and the Ornithological Society of New Zealand.

Follow the chart (www.niwa.co.nz/ncco/tools) using the methods and data sheet examples to see how Waikaraka community group are answering questions like:

- How do the characteristics of the mangroves change over time?
- What lives in the mangroves?
- What is the source of mud to the estuary, and where does it end up?

Mangroves are only one of a number of habitats which could be monitored within an estuary

Mangroves are coastal plants that can withstand a wide range of environmental conditions and thrive where fine sediment inputs are high

Seagrasses generally occur on intertidal flats and channels on the seaward side of the mangrove zone

Saltmarsh wetlands occur at the interface between land and mangroves

Activities in the catchment can result in contaminants, including sediments and nutrients entering rivers, streams, drains and eventually the estuary

KEY

- Sediments are deposited and resuspended
- Erosion can occur on unprotected shorelines
- Some fine sediments will make their way out of the estuary
- Macro-invertebrates live on the sediment surface (epifauna) and within the sediment (infauna) of saltmarsh, mangrove, seagrass, and bare sediments in estuaries

Symbols for diagrams courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science

Flow chart of actions

1 **Decide to monitor**

Community Group decides to initiate monitoring programme.

2 **Plan a monitoring programme**

Discuss the use of the guidelines with a research provider or regional council.

3 **Hold a briefing meeting**

Organise a meeting of interested community group members. A minimum of four members in the monitoring team is recommended.

Agenda

- Agree on long-term vision and goals.
- Choose at least two sites within the estuary where there is a mangrove boundary that you are interested in.
- Choose any additional site where you would like to measure changes in sediment height.
- Choose sites where you are interested in water clarity.
- Mark all sites on an aerial photo or map (see example below).
- Allocate responsibility for equipment (Page 8), and data sheets (www.niwa.co.nz/ncco/tools) and assign someone to maintain the data record.
- Make up a timetable for one year of monitoring.
- Plan for one full low tide period to set up the monitoring site. Allow about 4 hours for four people.

transect 1

transect 3

transect 2
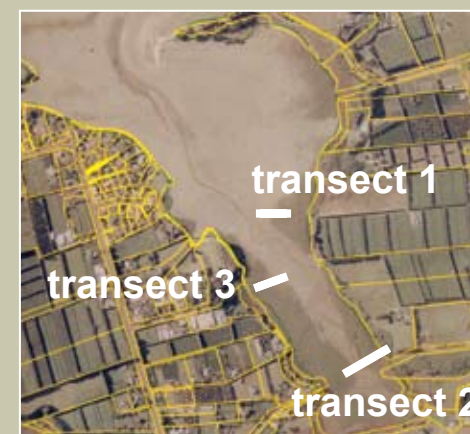
Example timetable

Task	How often	When
Monitor mangrove boundary characteristics	Annually	December
Count epifauna	Annually	December
Sediment height, penetrometer	Every three months	September, December, March, June
Water clarity	Every three months	September, December, March, June

4 **Hold a set up day, (methods are detailed on the following pages).**

1. Establish permanent transects
2. Record mangrove boundary characteristics
3. Count epifauna
4. Take photographs
5. Install sediment height monitoring pegs and record height above sediment
6. Make penetrometer measurements
7. Measure water clarity

5 **Monitor**

Every 3 months repeat measurements for methods 5 to 7

Every year repeat measurements for methods 1 to 4

Maintain records on paper, and if, possible in a computer spreadsheet

At least once a year, meet to assess progress, resources, findings, bottle necks, and make adjustments where necessary. Be prepared to make changes over the first year of your monitoring until you have a smooth repeatable system that can be carried out by a number of your group members. If possible, at this time it would also be prudent to involve a research provider or regional council representative to discuss your results.

Re-assess and allow for changes.

6 **Arrange for summaries of your findings to be presented to your community group**

1. Establish permanent transects

Goal: To establish permanent sites where measurements can be made to understand how the distribution and character of mangroves and adjacent habitats change over time.

It is likely that your main boundary of interest will be the seaward boundary between the mangroves and the tidal flats, and the wording in the methods reflects this. However, if relevant to your site, the same methods can be used across other boundaries, e.g., mangrove/saltmarsh.

At each site locate the start and end of your transects (two transects are recommended at each site). Mark each end of the transect by hammering in a wooden stake. Number the stakes to allow for future ease of identification. The length of the transect and the location relative to the mangrove boundary will depend on the characteristics of your site. The important thing is to ensure that the transect is long enough to cover the habitats of interest (e.g., mangrove boundary and mudflat, or mangrove boundary and saltmarsh). It is likely to be 20 to 50 m long. It is also important to place permanent markers so that the transect can be precisely relocated. It is recommended that a GPS reading is made where the stakes are placed in case the stakes are removed at any time.
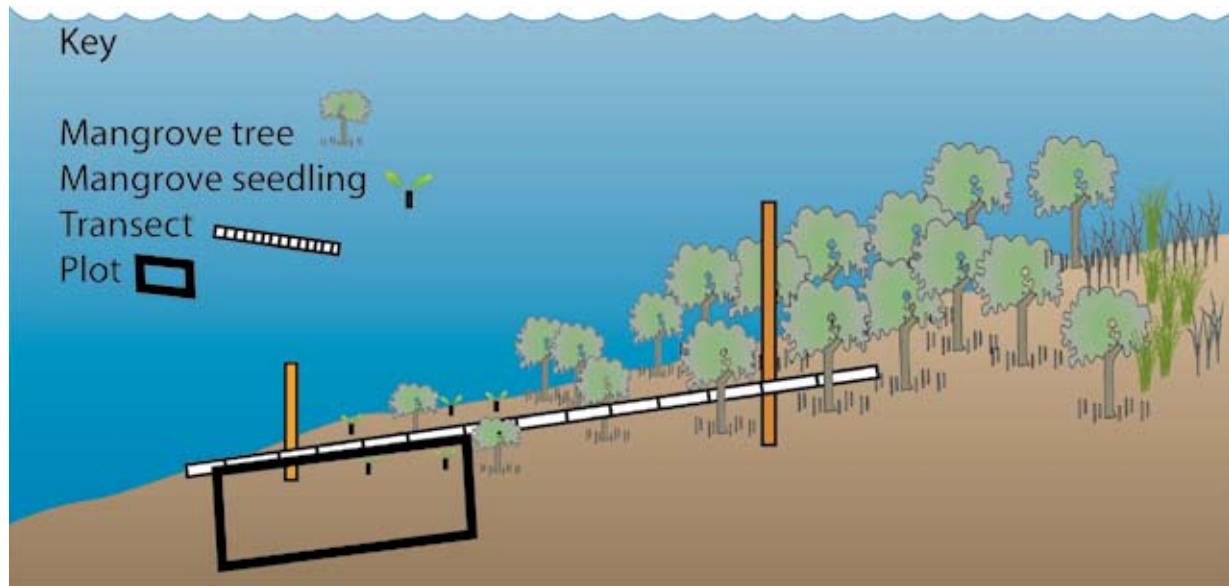
Key

Mangrove tree
Mangrove seedling
Transect
Plot

2. Record mangrove boundary characteristics

Goal: To measure changes in the distribution and character of a mangrove forest boundary and adjacent habitats over time.

On the day chosen for regular annual monitoring, lay a marked rope or measuring tape between the stakes, noting which peg is zero. This is your transect. Walk along one side of the transect line only (to avoid trampling) and note the distance on the measuring tape where there is a distinct change in the plant community (e.g., seagrasses, mangrove seedlings, saplings, pneumatophores, and mangrove trees) or bare ground. Also note different types of sediment (e.g., sand, mud).

Temporarily mark a rectangular plot of a known area, adjacent to your transect line. The size of the area will depend on the characteristics of your site (e.g., 5 m x 10 m was appropriate for sparse shrub and seedling cover on a sandflat in Tauranga).

The important thing is that one edge of the plot runs along the transect and that you keep an accurate record of the location relative to the transect for future reference. A sketch can help. Use the space provided on data sheet 1. Ensure that the plot overlaps the existing boundary of mangrove trees and an area where you might expect to see mangroves expand into over time.

Within the plot count:

· the total number of trees and measure the height of ten

· the total number of saplings

· the total number of seedlings

If the number of seedlings is too large to count, then count all individuals in a smaller area of known size, e.g., 1 x 1 m. Replicate if possible three times.

It is important to keep a record of exactly which methods were used each time you visit, including the size of the plots you used.

Example of how counts from the plot can be recorded in an Excel spreadsheet and then graphed to show changes over time.

	A	B	C	D	E	F	G
1	TRANSECT 1						
2		2003		2004		2005	
3	Number of Trees in 10 x 5 m plot		25		23		23
4	Number of saplings in 10 x 5 m plot		150		189		170
5	1x 1m replicate for seedlings	13		62		20	
6	1x 1m replicate for seedlings	11		28		43	
7	1 x 1m replicate for seedlings	13		13		9	
8	Average	12.0		34.3		24.0	
9	Number of seedlings in 10 x 5 m plot		600		1717		1200
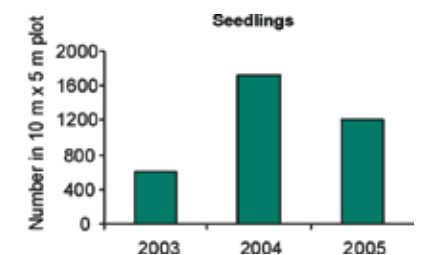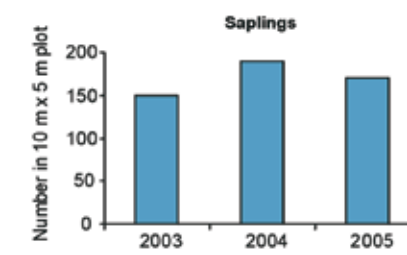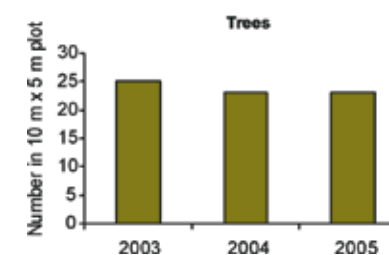
3. Count epifauna (animals living on the sediment surface)

(Use data sheet 3 - NIWA website - www.niwa.co.nz/ncwr/tools)

Goal: To characterise the animals that use different habitats within and adjacent to a mangrove stand.

Place a 25 x 25 cm quadrat at five haphazard locations, no further than 10 m from your transect line, within each of your main habitat types, e.g., mudflat, seedlings, mangrove trees.

Record the number of different animals seen on the sediment surface within each quadrat. A general field guide to marine invertebrates of N.Z. will be useful to help in identifications and you may like to make up a a guide specific to the animals you commonly find in your estuary.

It is important to include all of the animals that you see within the quadrats each time you visit the site. If there are very large numbers, you may need to count the animals in only one quarter of the quadrat and multiply the count by four.

	A	B	C quadrat number	D titiko	E mud whelk
1	Date Dec 2003				
2	Transect 1				
3	within trees		1	0	25
4			2	1	22
5			3	1	21
6			4	4	25
7			5	3	16
8		average		1.8	22
9	within saplings		1	2	13
10			2	1	12
11			3	3	13
12			4	1	11
13			5	0	9
14		average		1.4	12
15	on the sandflat		1	0	4
16			2	0	6
17			3	1	4
18			4	0	5
19			5	0	7
20		average		0.2	5.2

Example of how data can be recorded in an Excel spreadsheet. ▲

4. Take photographs

(Use data sheet 4 - NIWA website - www.niwa.co.nz/ncwr/tools)

Goal: To maintain a photographic record of each of the transects.

At each annual sampling, take a photograph from the same perspective at each of the transect markers. Any other photographs (e.g., of sediment height marker pegs) will provide a useful record for later comparison.

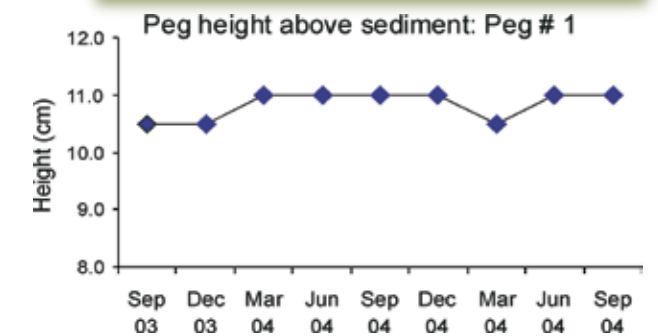## 5. Install sediment height monitoring pegs

(Use data sheet 5 - NIWA website - www.niwa.co.nz/ncwr/tools)

Goal: To measure rates of sediment accumulation or loss.

Hammer a series of wooden stakes*, firmly into the sediment (leaving up to 20 cm exposed). Number each peg for future identification. Place the stakes haphazardly along the transect line and at various distances away from the transect (alternatively choose a range of locations throughout the estuary that are within your areas of interest). Pay particular attention to having sufficient replication (5 stakes) both within the mangrove stand and around the boundaries of the mangrove forest. Lay a ruler on the ground next to the stake to account for any erosion close to the stake. Measure the distance from the top of the stake to the level of the ruler.

* Wooden stakes are susceptible to erosion at the base but are inexpensive and less likely to be tampered with than some alternatives. For further discussion of alternative techniques, see the "Mangrove Guidelines" (contact Environment Waikato) document.

*Example of how measurements from one peg can be presented to show change over time.* ▶

Peg height above sediment: Peg # 1

6. Make penetrometer measurements

(Use data sheet 6 - NIWA website - www.niwa.co.nz/ncwr/tools)

Goal: To measure the degree of sediment compaction at sites where sediment height monitoring rods are installed.

Sediment compaction is an important factor determining sediment re-mobilisation. A penetrometer measures the force required to penetrate the sediment to a given depth. Drop the penetrometer from a standard height of 1 m. Note the depth to which the steel rod penetrates and repeat this process 10 times around each sediment height monitoring rod. Use a ruler to measure the height of the penetrometer above the sediment surface. The penetrometer should be measured only when it is roughly vertical. Calculate the average of the 10 measurements. Repeat every three months.

Example of how data from two pegs measured four times in a year can be plotted to show changes over time. ▶
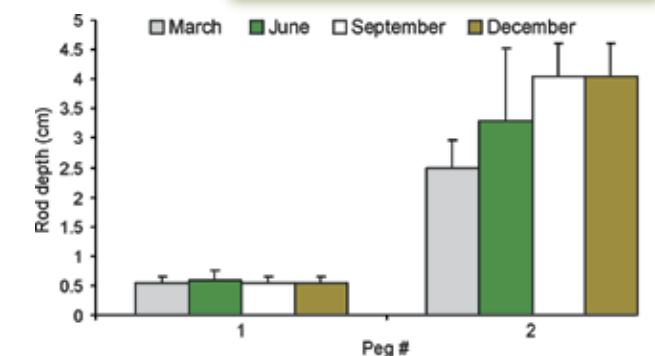
7. Measure water clarity

(Use data sheet 7 - NIWA website - www.niwa.co.nz/ncwr/tools)

Goal: To compare tributaries and how water clarity changes as a result of sediment remobilisation at different places within the estuary.

Use a NIWA clarity tube to measure water clarity at selected sites at three monthly intervals. Fill the tube with water at the site and move the black magnetic indicator until it just disappears from view. Record the average value of up to three members of the team. Note the time at which measurements were made.

It is important to thoroughly rinse the tube with fresh water after use.

In addition to your regular monitoring, extra measurements are recommended immediately following storm events or heavy rainfall.

Example of how water clarity data can be presented. After rainfall, tributary 2 was notably more turbid, and this affected clarity further down the estuary.

▶
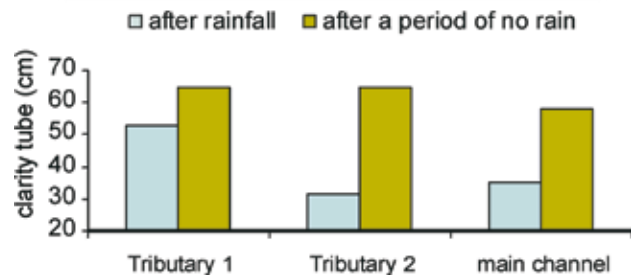
Useful terms as they are used in this document		Equipment List
Mangrove seedlings:	Plants less than 25 cm tall.	**Setup day only**
Mangrove saplings:	Bigger than a seedling (> 25 cm tall) but have not branched.	• Four numbered wooden stakes (about 100 x 5 x 5 cm)
Mangrove trees:	Mangrove plants larger than a sapling and branched.	• Sledgehammer • Ten numbered wooden stakes, 100 x 2 x 2 cm
Mangrove boundary:	Limit of trees where only saplings and seedlings are found.	• GPS
Pneumatophores:	Aerial roots for gas exchange.	**Regular monitoring**
Epifauna:	Animals living on the surface of the substrate.	• Backpack • Camera
Infauna:	Aquatic animals living within the sediment.	• Data sheets and pencil • Camera
Habitat:	The place where environmental conditions are suitable for the survival of a particular organism (e.g., mangroves).	• 50 m measuring tape • Ruler • Penetrometer sharpened steel rod (40 cm long, 0.7 cm diameter)
Site:	General area of interest within an estuary, likely to be at the scale of a bay or inlet.	• Water clarity tube • Watch
Transect:	A line on the ground along which sample plots or points are established for collecting data.	• ID sheets • 25 x 25 cm quadrat • Aerial photo/map showing location of sites
Quadrat:	A square with sides of equal size, e.g., (25 x 25 cm) within which counts can be made of organisms in a known area.	• Temporary corner pegs and string for marking plot
Replicate:	More than one sample unit to account for natural variability.	