Habitat Mapping

He Tirohanga

Our problem is, Ngātokakairiri, just out by the Ōpārau River…the place is absolutely covered in oysters now and that is one of the only golden sand beaches on this side of the harbour, the beach is absolutely covered in oysters now, that weren't there 15, 20 years ago. And so what was traditionally a swimming place and where we get other kind of kai has been overtaken by the Pacific oysters and I think that's probably the case, a lot of places here, that weren't actually getting them there, they were only in key places such as Pūtī and other places but now they're just spreading everywhere eh!

– a hapū member from Ngāti Hikairo of Kāwhia

As a kid [1950s], we used to go off there near Red Point. There used to be a fig tree and you used to go about two chains [40 m] and we'd pick periwinkles. We use to call them pupu the one with the cellophane front. Used to get them right there. If you go there now you'll look out from that point and you see the big old mangroves. Well that was the end of them right there. Only about a chain, two chain off the road. Now it stretches half a mile or more. Oh I think it stretches a kilometre or more. I'm not sure of the scale on here but...the mangroves go a long way down and it's hard to get a feed of those periwinkles any more.

– a hapū member from Ngāti Whanaunga of Manaia

Mapping and monitoring habitats in your estuary

This **Habitat Mapping module** will show you how to collect information to describe and monitor habitats in estuaries. A habitat map includes information on the locations and sizes of each habitat type, which may include: sandflats, mudflats, tidal channels, shellfish beds, saltmarsh, seagrass meadows, and mangrove forests. Habitat mapping is an important part of understanding your estuary. It provides the necessary context or 'big picture' for the environmental changes that you may observe at a particular location. For example, how much of the estuary is covered by different habitats (e.g., mudflats, sandflats and saltmarshes), and where each of these habitats is located in relation to each other. An accurate habitat map will also enable you to identify habitat changes that may occur in the future, such as increases in mudflats habitat due to mud depositing on sandflats. This type of habitat change may also have flow-on effects, such as colonisation of mudflats by mangrove forests. Its important to undertake a baseline habitat mapping survey at an early stage during your monitoring project because this will provides the 'yardstick', by which you can measure habitat changes in the future.

Before using any of the tools described in the Habitat Mapping module please read the introductory and safety information in the **Getting Started module**.

Introduction

New Zealand estuaries include many different habitat types, such as sandflats, mudflats, tidal channels, shellfish beds, saltmarsh, seagrass meadows and mangrove forests. Because estuaries are highly dynamic environments subject to processes occurring on the land and in the sea, the locations, sizes and types of habitats can change relatively quickly, or form over years or decades. Each habitat type has different **ecological** functions as well as values for people.

Knowledge of the condition of the whole estuary allows you to assess its value for cultural and recreational activities, for provision of kaimoana stocks (fish and shellfish), and as a source of spiritual, mental, physical, whanau and community well-being, and whether it is a healthy, functioning ecosystem.

Key indicators of healthy estuaries include:

- presence of a variety of habitats, including saltmarsh and seagrass
- only small or no increases in the muddiness of estuary sediments
- water clarity is suitable for growth of submerged aquatic plants (e.g., seagrass)
- blooms of nuisance algae such as sea lettuce do not occur or are rare
- low levels of chemical pollutants in estuary sediments. Common types of these pollutants include nutrients (i.e., nitrogen and phosphorous) and metals (e.g., zinc and copper)
- good condition of the plants and animals in your estuary. For example, seagrass meadows are green and lush and there is always enough kaimoana available given the same level of harvesting over time.

To monitor your estuary health as a whole, you need to undertake a **baseline survey** to map the location of habitat types in your estuary. An initial habitat map can be made using published information such as **topographic maps**, hydrographic charts and aerial photographs. However, to finalise your baseline habitat map you will need to check or **ground-truth** the map by visiting your estuary and surveying the locations of habitat types. Methods for constructing and ground-truthing a baseline habitat map are described in this module.

Monitoring your estuary over time will enable you to update your habitat map and identify any large-scale changes or trends that are occurring. Ground-truth surveys conducted at five-year intervals should be sufficient in most cases. Information provided by more frequent monitoring at specific sites using tools provided by other modules (e.g., **Sediments, Plants, Shellfish modules**) will help you decide if more frequent updates of your habitat map are required.

Another important function of the baseline habitat map is that by knowing the general locations of habitats you will be able to make informed choices about where you might conduct more detailed monitoring of the physical and biological state of your estuary.

Using this module

The **Habitat Mapping module**, will help you be to determine:

- habitat types occurring in your estuary (baseline survey)
- the number, size and location of each habitat type
- if the size (larger or smaller) and/or location of habitat types is changing over time.

This module shows you how to:

- use existing information to construct a baseline estuary habitat map
- ground-truth your baseline estuary habitat map
- select and establish your survey sites for monitoring enironmental changes over time
- identify and map the different habitats in your estaury

Links to the New Zealand Curriculum for schools

This module serves as an introduction to estuarine studies and provides critical baseline information for the ongoing monitoring of an estuary's health. Habitat mapping also helps to contextualise other modules in the *Ngā Waihotanga Iho – Estuary Monitoring Toolkit* programme (like the **Sediments, Plant** or **Fish modules**). Students are introduced to scientific procedures essential to undertake sustainable environmental studies, (i.e., construction of baseline habitat maps using existing information followed by ground-truthing of the maps through field surveys). They are made aware of relevant existing data sources like topographic and hydrographic charts, aerial photographs, historical information. Key scientific communication skills including the mapping of data onto maps and aerial photographs are also covered, where students are taken through the steps of building a baseline estuary habitat using the Whangateau estuary as an example. This example is followed by guidelines for ground-truthing the 'draft map', using observations made in the field while conducting transects.

The habitat module relates to all aims of the New Zealand Curriculum (NZC) Nature of Science strand from Levels 5–8 (Years 9–13) and certain themes within the Planet Earth and Beyond strand. At Years 9 and 10 (Level 5 of the NZC) the following achievement objectives can be addressed using the scientific approaches contained in this module. The approaches are ideal for individual and group student investigations into their local environment, especially in the senior school, and for identifying trends over time if done annually as whole-class tasks, for example in the junior school.

The Nature of Science (Level 5)

Understanding about science.

- Understand that scientists' investigations are informed by current scientific theories and aim to collect evidence that will be interpreted through processes of logical argument.

Investigating in science

- Develop and carry out more complex investigations, including using models.
- Show an increasing awareness of the complexity of working scientifically, including recognition of multiple variables.
- Begin to evaluate the suitability of the investigative methods chosen.
- Communicating in science.
- Use a wider range of science vocabulary, symbols, and conventions.

- Apply their understandings of science to evaluate both popular and scientific texts (including visual and numerical literacy).
- Participating and contributing.
- Develop an understanding of socio-scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions and to take action where appropriate.

Planet Earth and Beyond (Level 5)

Earth systems

- Investigate the composition, structure, and features of the geosphere, hydrosphere and atmosphere.

Years 11–13 NCEA links

In the senior school (Years 11–13) most students will be working towards the requirements of the National Certificate of Educational Achievement (NCEA) qualification. All achievement standards for the National Certificate of Educational Achievement (NCEA) have been reviewed to align them with the 2007 NZC document. The following achievement standards from the 2014 NCEA subject matrices are appropriate to assess aspects of student learning that are outcomes of the **Habitat Mapping module**.

Biology

Biology 1.1	Carry out a practical investigation in a biological context, with direction.
Biology 2.1	Carry out a practical investigation in a biological context, with supervision.
Biology 3.1	Carry out a biological investigation in a biological context, with guidance.

Earth and Space Science

ESS 2.1	Carry out a practical Earth and Space Science investigation.
ESS 3.1	Carry out an independent practical Earth and Space Science investigation.

Geography

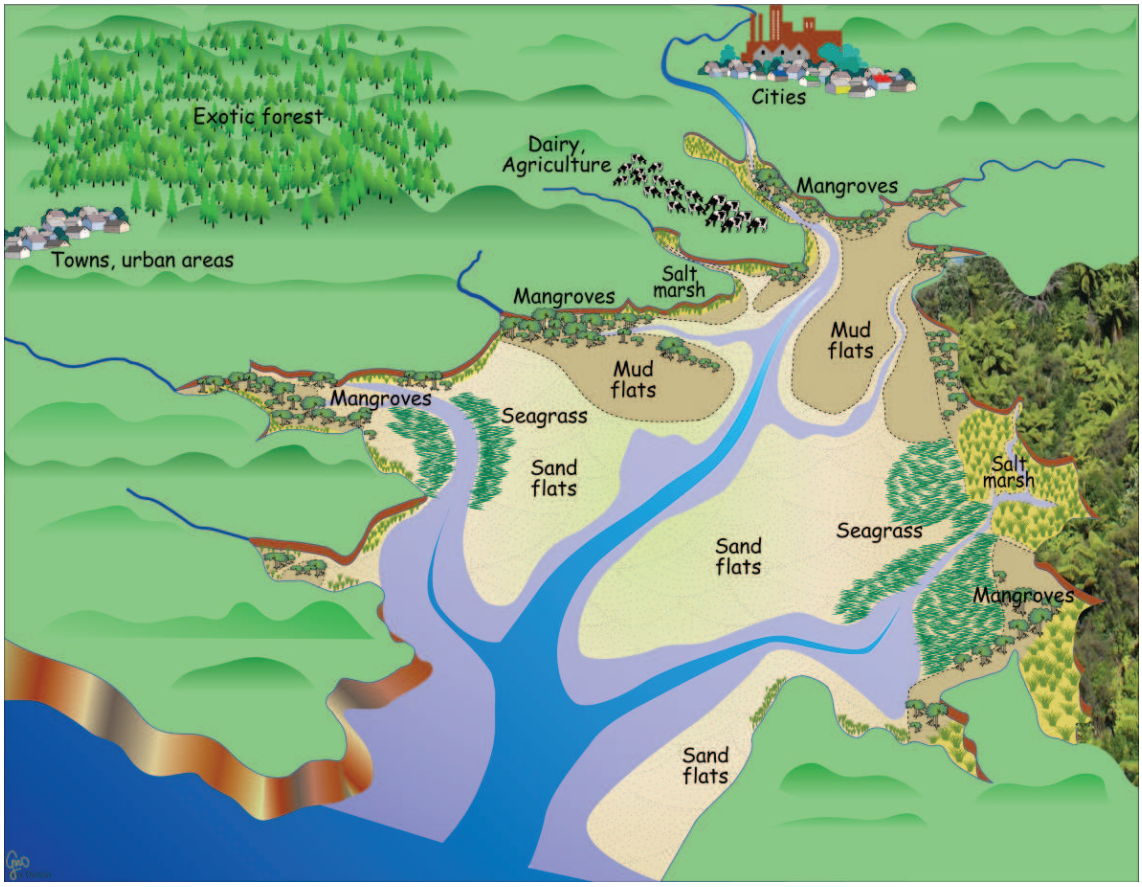
Geo 1.4	Apply concepts and basic geographic skills to demonstrate understanding of a given environment.
Geo 2.4	Apply geographic concepts and skills to demonstrate understanding of a given environment.
Geo 3.4	Demonstrate understanding of a given environment(s) through selection and application of geographic concepts and skills.

Getting started

What are habitats in estuaries?

The first step in making a habitat map is to understand what the different habitat types are. Habitat types differ with sediment types and the type and abundance of plant and animal species that are present.

There are several major habitats that commonly occur in New Zealand estuaries, these habitats are described below.



This conceptual diagram includes many of the common features of New Zealand estuaries and their catchments.

Mudflats (soft sediment that you will sink into). Sticky sediment, often with a distinct sulphurous odour of rotten eggs (e.g., like visiting Rotorua). You will sink into this sediment at least up to your ankles or often much deeper. Commonly found in areas sheltered from wave action, near high tide mark, and in tidal creeks near river and stream mouths. Crab holes are usually common.

Mudflats.

Mixed mud/sandflats composed of mud and sand. You won't sink into this sediment like you would on a mudflat. Ripples may occur on the sediment surface. These mixed-sediment tidal flats are common in New Zealand estuaries.

Mixed mud/sandflats.

Sandflats (firm sediment that you will not sink into). Your feet will sink no more than 2 cm if the sand is hard packed. If the sandflat has recently been reworked by waves or tidal currents there are likely to be ripples on the sediment surface and the sediment may contain lots of water so that it is soft. Shells may also be common.

Sandflats.

Shellfish beds in a mudflat and/or sandflat. This habitat may be characterised by large quantities of shell and shells fragments on the sediment surface, which may include cockle, pipi, macomona, tuatua, toheroa, pupu shells.

Shellfish bed.

Gravel/cobble. Beds of gravel and/or cobbles. These sediments have particle diameters that are greater than 2 mm. Sand usually does occur between and underneath the cobbles and pebble.

Gravel/cobbles.

Rock platform. Bare rock surfaces or rock encrusted by plants and animals, such as seaweeds and shellfish. The rock surface may also be buried below a layer of sediment.

Rock platform.

Oyster/mussel reef. A reef built from living and/or dead shellfish. Oyster reefs may occur on rock platforms or boulders and may also develop on dead shell material.

Oyster reef.

Macroalgal bed. A large algae usually found on sandflats and most commonly occurring in summer. The common types are sea lettuce (*Ulva* spp) which forms green sheets on the sandflats, and Neptune's necklace (*Hormosira banksii*) which resembles a brown pearl necklace.

Macroalgal bed of se lettuce.

Vegetated tidal flats. These habitats are characterised by growth of plants on the sediment surface. Because plants are highly effective at reducing wave action and tidal currents, muddy sediments are deposited in vegetated habitats. The most common vegetated habitats are briefly described here. The **Plant module** describes these habitats in more detail.

(A) Saltmarsh (repotai)

These communities may be broadly divided into three zones: marsh ribbonwood, rush/sedge and herbfield.

(1) Marsh ribbonwood zone. Occurs above and at high-tide level and includes species such as marsh ribbonwood (mākaka), sea primrose (mākoako), *Selliera* (remuremu), and buggar grass.

Marsh ribbonwood zone of saltmarsh habitat.

(2) Rush/sedge zone. Occurs above the mid- to high-tide level and is generally made up of single species such as oioi (golden jointed rush) or sea rush (wīwī), depending upon site conditions. For example, sea rush generally prefers to grow in muddy sediments and will often tolerate being submerged by the tide for longer periods than oioi. Saltmarsh communities may also contain pest plants including saltwater paspalum and cord grass (***Spartina***), which was first introduced to New Zealand in the early 1900s. Cord grass was planted widely in estuaries to stabilise tidal mudflats and to protect low-lying shorelines from wave action. However, ***Spartina*** marshes have spread rapidly in some estuaries, replacing native saltmarsh and smothering sandflats. Today it is considered a pest plant and regional councils and the Department of Conservation have undertaken ***Spartina*** control work using herbicides.

Rush/sedge zone of saltmarsh habitat.

(3) Herbfield zone. Occurs above mid- to high-tide level and is dominated by flat mat-forming plants such as sea primrose (mākoako), remuremu, glasswort (ureure), and sea blight. In fact, the seaward edge of glasswort can be used to identify the approximate position of the mean high water mark (appendix **On the Level)**. Other plant species found in the saltmarsh herbfield zone are buggar grass on coarse or rocky outcrops, and bachelor's button, sharp spike-sedge, wīwī (knobby clubrush), slender clubrush, and arrow-grass in more **brackish** (slightly salty) areas.

Herbfield zone of saltmarsh habitat.

(B) Mangrove forest (mānawa)

Mangrove forests (mānawa) are found in upper North Island estuaries, naturally extending as far south as Kawhia Harbour on the west coast, and Ohiwa Harbour on the east coast. Mangrove distribution in New Zealand is limited by climate, particularly cool winter air temperatures and the frequency and severity of frost. Within estuaries where they occur, mangrove distribution is controlled by the height of the tidal flat, only occurring above mid-tide level as seedlings cannot cope with being submerged for more than about six hours per tide. Waves may also influence the establishment of seedlings so that mangrove forests may not occur or spread more slowly on tidal flats where wave action is consistently high. Mangroves have several life-cycle stages including seeds, seedlings, saplings, and mature trees with their **pneumatophores** (air-breathing roots that grow vertically out of the mud). Mangrove trees can grow up to about 8 m high depending upon climate, sediment composition, nutrients and salinity. Generally, young mangrove forests consist of large numbers of saplings and seedlings with relatively small numbers of pneumatophores. In comparison, old mangrove forests contain mature trees, large numbers of seedlings and **pneumatophores**, but few saplings, and occur on compacted, organically rich sediment covered with large amounts of decaying leaf litter.

Mangrove forest (mānawa).

(C) Seagrass meadows (karepō)

Seagrass or eelgrass (karepō) meadows are commonly found within estuaries, growing on tidal flats at or below low-tide level. Seagrass communities consist of a single species of plant. The plants have a short shoot with 3 to 5 strap-like leaf blades and runners called **rhizomes** with fine roots that creep through the sediment. Most New Zealand seagrass plants have leaf blades that grow up to 15 cm long and 0.5 cm wide. Seagrass spreads by sending up shoots from the runners that grow into new plants. Seagrass meadows sometimes contain Neptune's necklace, a common brown seaweed.

Seagrass (karepō) meadow.

You will find descriptions of each of these estuary habitat types in the illustrated field guide that accompanies this **Habitat Mapping module**.