Enviroteach

An Environmental Education Resource for Teachers

From the Editor

Kia ora – Happy New Year!

This issue of *Enviroteach* focuses on estuaries. It includes information for teachers on these remarkable ecosystems and lots of ideas for exciting activities for field trips and classroom-based learning.

Our education team is available to assist you with a wide range of environmental topics and we'll be delighted if you choose to focus on estuaries during 2015. Please contact Environment Southland if you would like one of our trained teachers to come and talk to your class, assist with a field trip, or help you plan a project. There is no charge for this service. We can also provide you with a number of helpful educational resources to support learning about estuaries. Call 0800 76 88 45 or email education@es.govt.nz to make a booking.

All the best for term one!

Pat Hoffmann
Environmental Education Officer

environment SOUTHLAND
Te Taiao Tonga

Inside this issue

Published by Environment Southland | www.es.govt.nz | education@es.govt.nz | 0800 76 88 45

What is an estuary?

An estuary is a partly-enclosed body of water formed where freshwater from rivers and streams flows into the sea and mixes with the seawater.

Because they are located at the bottom of river catchments, estuaries are places of transition from land to sea and from freshwater to saltwater. These influences make estuaries dynamic ecosystems that naturally undergo rapid changes in water chemistry, such as shifts in water temperature, salinity (saltiness), dissolved oxygen and turbidity (cloudiness). These shifts are largely to do with the fluctuating influences of tides, freshwater inflows and wind, and the influence of the estuary's overall shape. The characteristics and behaviour of sediments (gravel, sand, silt and clay) on the bed of the estuary also influence water chemistry. For example, sediments dominated by sand and gravel (larger grain sizes) are usually better-oxygenated than sediments dominated by silt and clay (finer grains).

ACTIVITIES – Water chemistry investigations

Students can learn about water chemistry by doing simple science investigations in an estuary. You don't need an extensive background in chemistry or sophisticated equipment to supervise these activities.

- Measure water temperature using a digital thermometer
- Measure turbidity using a clarity tube
- Measure salinity using a homemade hydrometer *(for detailed instructions, visit http://www.marinediscoverycenter.org/wp-content/uploads/2013/06/Curriculum-Guide_Final.pdf)*
- Students with access to a chemistry laboratory can measure dissolved oxygen by doing Winkler titrations.

Ideas for extension

Take measurements at different times of the day and in different parts of the estuary. Report on the range of values and the average for the estuary. Look for patterns between variables (e.g. you would expect salinity to be lower at low tide and while it is raining). Repeat the tests with freshwater and seawater samples and compare the results.

If you would like an education officer to accompany you and assist you with your field trip, please contact us and make a booking. If we are not available, you may be able to borrow our equipment.

Call 0800 76 88 45 or email education@es.govt.nz

Why are estuaries important?

Estuaries are very special ecologically because:

- The sheltered, tidal waters of estuaries support a unique community of plants and animals that have adapted to cope with the physiological stresses caused by fluctuating physical conditions.
- Estuaries provide a wide range of habitats and can therefore support many species of plants and animals.
- Estuaries are highly productive ecosystems because they are rich in the nutrients needed for plant growth – especially nitrogen and phosphates. These nutrients are continually being replenished by rivers, runoff from the land, and the sea.
- Seagrass (*Zostera*) is an important estuarine plant. Seagrass beds stabilise sediments, and provide food for estuarine animals, nursery areas for juvenile fish and grazing areas for waterfowl. Macroalgae such as sea lettuce (*Ulva lactuca*) and *Gracilaria* occur naturally in estuaries in Southland, but excessive nutrient and sediment input has created conditions where they proliferate and become a nuisance. Estuarine plants provide homes and food for invertebrates such as worms, snails and crustaceans which live on and in the sediments, except where these nuisance algae proliferate.
- Invertebrates are good indicators of estuarine health. A healthy estuary can support a wide range of invertebrate species, while an unhealthy estuary can support only a small number of different types of pollution-tolerant species. Invertebrates provide food for juvenile and other small fish, which may in turn be hunted by larger fish.
- Many fish species use estuaries for part or all of their lifecycle, for example flounder, trout, eels and mullet.
- Estuaries provide vital feeding areas for many species of birds – especially waterfowl and waders. Southland boasts a number of estuaries considered to be of national and international significance to birds. Many of these birds, such as the Eastern bar-tailed godwit/kuaka, are international migrants which make an annual journey from their Siberian breeding grounds for summer feeding.

Estuaries also have high value for people as places for harvesting food, recreation and their aesthetic and economic value.

ACTIVITY – Harvesting bull kelp to make pōhā

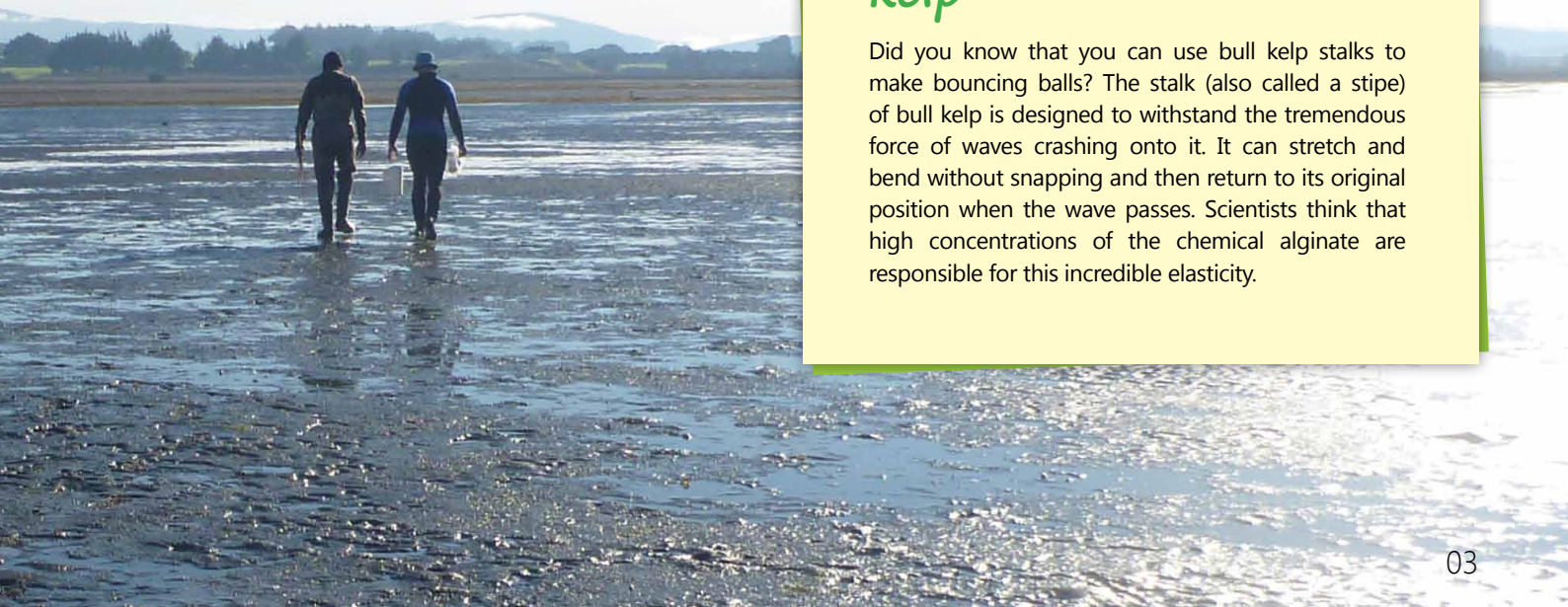
Bull kelp (rimurapa) is a large brown seaweed (*Durvillaea* species) that is used by South Island Māori to make traditional bull kelp bags (pōhā) for packaging and preserving food such as muttonbirds (tītī). Food preserved inside a pōhā can be kept safely for two to three years! According to Ngāi Tahu tradition, January or February is the time to start making pōhā.

Bull kelp has "the toughness, texture and flexibility of tanned leather, the waterproof qualities and airtight seal of modern-day plastics and the strength and stretch of industrial rubber. What's more, it is absolutely natural and totally biodegradable. Ngāi Tahu, who regard rimurapa as a taonga species, make the most of these properties with the annual harvest of their precious tītī from the offshore islands of Rakiura (Stewart Island)." *(Te Karaka, Spring 2011).*

Read this account of how pollution in our coastal ecosystems is affecting the harvesting of bull kelp: www.ngaitahu.iwi.nz/wp-content/uploads/2013/09/TeKaraka51.pdf

ACTIVITY – Make a bouncy ball from bull kelp

Did you know that you can use bull kelp stalks to make bouncing balls? The stalk (also called a stipe) of bull kelp is designed to withstand the tremendous force of waves crashing onto it. It can stretch and bend without snapping and then return to its original position when the wave passes. Scientists think that high concentrations of the chemical alginate are responsible for this incredible elasticity.



MARINE METRE S

Marine Metre Squared (Mm^2) is a new nationwide citizen science project that encourages people to get out and explore their local seashore. Mm^2 is ideal for school field trips to estuaries or rocky shores as it provides an easy method for students to survey plants and animals, and store their data. By repeating the survey at the same site, you can build a picture of seasonal changes and health trends at your site. Anyone can take part – individuals, families, schools and community groups – and registration is free. Registered members get full access to the online Mm^2 database where they can upload their survey data, compare their shore with the rest of New Zealand and monitor changes over time. Registered members can also join an online community to connect with other members of the Mm^2 network, get help with species identification, take part in new projects and challenges, and suggest projects of their own.

Contact Environment Southland if you would like one of our education officers to assist you with a muddy or rocky shore study. Call 0800 76 88 45 or email education@es.govt.nz.

Our Marine Metre Squared field trip

By Pat Hoffmann

On 13 November, teachers from three Enviroschools in Southland and staff from Environment Southland participated in a Marine Metre Squared field trip run by Sally Carson, programme director at the New Zealand Marine Studies Centre in Otago. We travelled to Mokomoko Inlet near Omaui at low tide and completed two surveys of the muddy shore – one in the low shore zone and another in the mid shore zone.

1

We placed our $1m^2$ quadrat at a randomly chosen site on the soft shore of the estuary.

2

We identified and counted all of the animals we could find living on the surface (epifauna) within the quadrat.

3

The Sandy & Muddy Shore Guides were extremely helpful. It was a good thing they were printed on waterproof paper!

4

We estimated percentage cover of each seaweed species using the lid of an icecream container which had a hole cut out of it to represent 1% of the quadrat.

5

We recorded everything we found on a handy fieldsheet downloaded from the Mm^2 website.

QUARED

www.mm2.net.nz

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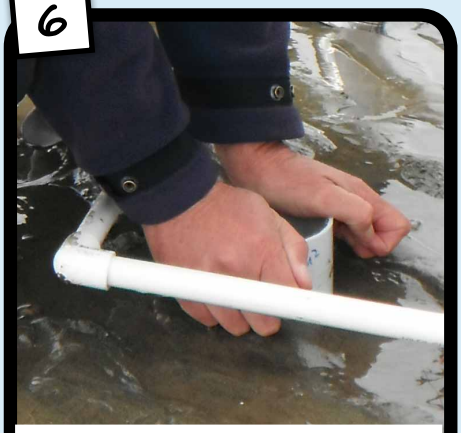


We pushed a tin can into the sediment to obtain a core sample, and then used a trowel to dig it out. We collected four of these core samples per quadrat.

7

We carefully emptied the contents of each can into a sieve and looked for any signs of black, anoxic sediment (the RPD layer). We also measured the depth of the RPD layer below the surface. See page 7 for more info on the RPD layer.

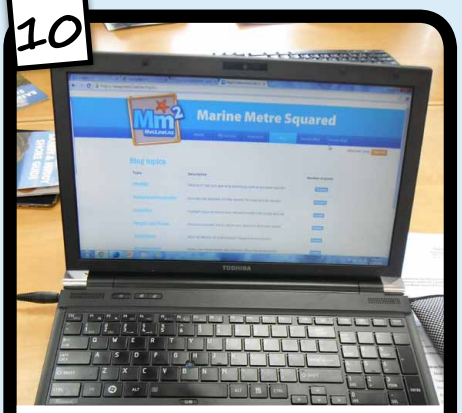
8

We sieved the core samples and identified animals we found in the sediment (infauna). There were more cockles and worms living in the sediment than on the surface.

9

We saw some fascinating creatures, including crabs, a ghost shrimp, snails, whelks, limpets, wedge clams, cockles and worms. Our most surprising discovery was this super-smelly sulphur worm!

10

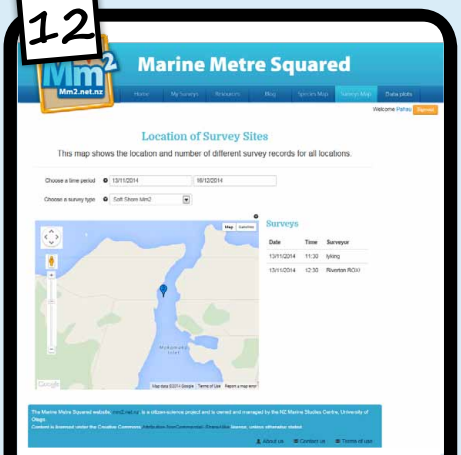


Back in the classroom we logged onto the Mm² website and added a new Soft Shore survey. We entered the data from our fieldsheet, added some photos and a post to the blog.

11

The Mm² programme used our data to calculate the diversity of plants and animals at our site (Margalef's Index), and the abundance of each species per m².

12



Now anyone can visit the Mm² website and see the results of our surveys, beautifully presented in a series of tables and pie charts.

Estuary health

Estuaries are vulnerable ecosystems. They act as natural 'sinks' for runoff from the freshwater catchments that drain into them. Their health therefore acts as an 'indicator' of the overall health of their catchments. Sedimentation, excessive nutrients, toxic contaminants and habitat loss are issues that affect estuaries throughout New Zealand:

- The current rate of sedimentation in New Zealand estuaries is about 10 times greater than before Europeans arrived.
- Nutrient enrichment (or eutrophication) occurs when an estuary receives too many nutrients from agricultural activities, wastewater treatment plants and industrial discharges.
- Nuisance macroalgae - Nuisance blooms of rapidly-growing algae can occur when water receives too many nutrients. Algae such as *Gracilaria* and *Ulva* may form extensive mats – particularly in summer when conditions are warm and calm. When these mats of algae rot down, bacteria use up the oxygen in the sediment and only certain invertebrates can survive (pollution-tolerant species). Large quantities of rotting algae give off hydrogen sulphide gas which smells like rotten eggs. Hydrogen sulphide is toxic to other plants and animals and is quite nauseating for people. Food sources for fish and birds, such as marine worms and other invertebrates, find it difficult to survive within hydrogen sulphide-rich, oxygen-starved sediment.
- Contaminants that accumulate in estuaries include heavy metals from road and roofing runoff, industrial and commercial discharges, wastewater and rural practices. Some animals, such as shellfish, accumulate these toxins in their flesh.
- Habitat loss - Most of Southland's estuaries have large intertidal flats that are dry at low tide. This is an advantage to wildlife because it provides a diversity of habitats which can, in turn, support a wide variety of species. Land reclamation, drainage, grazing, dredging and weeds reduce the diversity and quality of habitat available to wildlife.

Environment Southland monitors eight estuaries, one harbour and one lagoon as part of our estuary programme. Visit www.es.govt.nz/environment/coast/estuaries/ for a list of reports on estuaries currently monitored by Environment Southland and details of what we monitor.

ACTIVITY – Make a tide mobile

You will need:

cardboard
tape
string
paint and paintbrushes
coat hanger
hole punch
two sticks (one long and one short)

1. Draw a star, sun, moon and earth on a piece of cardboard and cut them out.
2. Paint the sun yellow, the moon purple, the earth blue and green, and the star white.
3. Punch a hole in the top of the star, sun, moon, and earth and tie a short piece of string through each piece.
4. Construct the mobile according to the diagram shown.
5. Ask the students to use the mobile to model various phases of the moon. What would the mobile look like during a spring tide? A neap tide?

(Source: www.marinediscoverycenter.org/wp-content/uploads/2013/06/Curriculum-Guide_Final.pdf)

Questions students can investigate to determine whether estuary health is declining

Sedimentation

- Is the total area of soft mud in the estuary increasing?
- Is the rate of sedimentation increasing?
- Are estuary sediments becoming dominated by fine particles?

Eutrophication

- Is there evidence of excessive plant growth, phytoplankton or algal blooms?
- Is there only a limited range of pollution-tolerant invertebrate species?

Habitat quality

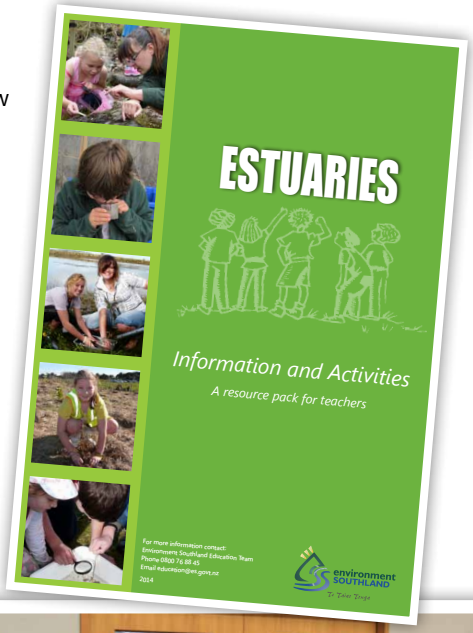
- Is the overall extent of 'good habitat' (saltmarshes and seagrass meadows) decreasing?

Depth of the Redox Potential Discontinuity (RPD) layer in the sediment

- The Redox Potential Discontinuity (RPD) layer is a distinct zone between the oxygenated sediment and the anoxic sediment. The oxidized layer is brown in colour, while the anoxic layer below this is black. Students can measure the depth of the RPD below the surface. An RPD layer close to the surface is indicative of poor oxygen conditions in the sediment.

Educational resources

Estuaries resource pack



Contact the education team at Environment Southland to request your FREE copy of our new Estuaries resource pack (Tollfree 0800 76 88 45, email education@es.govt.nz), containing:

- Links to online educational resources
- Fact sheets
- Educational activities
- Identification guides
- A copy of Environment Southland's publication, *The Squawk*, Term 1 2013, focusing on estuaries.

Bathing sites

Every summer, Environment Southland monitors bathing water quality at 13 marine and seven freshwater sites in Southland. Visit our website to find out what the public health risks are, what is being done and whether it is safe to swim, and to download a report on the microbial monitoring programme – *www.es.govt.nz/environment/coast/bathing-waters*.

EnviroScape model

Environment Southland's EnviroScape model can help your students to understand what a catchment is; how human activities on the land produce contaminants; and how runoff from the land carries sediment, nutrients and other contaminants into streams which feed into estuaries. Invite one of Environment Southland's education officers to visit your class with the EnviroScape model.

Call 088 76 88 45 or email education@es.govt.nz to make a booking.

Upcoming events

2015 Southland Environment Awards nominations

The Southland Environment Awards are held every year by Environment Southland to acknowledge the huge amount of good work being done - often behind the scenes and voluntarily – to safeguard and enhance Southland's environment.

Nominations for the 2015 Southland Environment Awards will be open from 23 March to 1 May - so starting thinking about who you would like to nominate. There are categories for individuals, schools, community groups, businesses and farmers.

Check our website for details and a nomination form in March, or call Adrienne Henderson on 0800 76 88 45.

Seaweek is New Zealand's annual national week about the sea. Hosted by the NZ Association for Environmental Education, Seaweek focuses on learning from the sea. It's about exciting and inspiring all New Zealanders to renew their connections with the sea! Not just for children or those involved with formal education – it's a time for all of us to get to know our ocean, its habitats, characteristics and inhabitants better. Seaweek 2015 will take place from Saturday 28 February to Sunday 8 March 2015. The theme is "Look beneath the surface – Papatai ō roto – Papatai ō raro".

www.seaweek.org.nz