WETLANDS
for Education in the West Coast *Tai Poutini* Conservancy

January 2005 Edition 2

Department of Conservation
Te Papa Atawhai

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CONTENTS

USING THIS RESOURCE

This resource is designed to help you plan exciting and educational conservation learning experiences inside and outside the classroom. It is not site specific but focuses on West Coast wetlands. To help you there are fact sheets covering the main information about wetlands. There is a list of pre and post visit activities and a range of worksheets for use in the class and out in the field. The activities are designed so that they can be adapted to suit any level from lower primary to upper secondary. Initially the information here is aimed at upper primary. Because this resource is not site specific you may find some of the information is not relevant to your unit so use only the information and activities you need. A list of related resource material is included at the end to guide you to more in-depth information.

THE CURRICULUM

Environmental Education

Environmental Education involves the integration of 3 key dimensions: promoting education *about*, *in* and *for* the environment through personal commitment and action.

The aims of Environmental Education are for students to develop:

1. **awareness and sensitivity** to the environment and related issues;
2. **knowledge and understanding** of the environment and the impact of people on it;
3. **attitudes and values** that reflect feelings of concern for the environment;
4. **skills** involved in identifying, investigating and problem solving associated with environmental issues;
5. a sense of responsibility through **participation and action** as individuals or members of groups, whanau or iwi, in addressing environmental issues.

SOURCE: Ministry of Education (1999) Guidelines for Environmental Education in New Zealand Schools

This wetlands resource has been developed to encourage you and your class to visit wetlands in your 'backyard'. Site visits can be used to meet goals from specific curriculum areas or different areas simultaneously. A trip might be planned to meet objectives from some of the curriculum and strands below.

Social Studies: Place and the Environment, Time, Continuity and Change, Resources and Economic Activities and Culture and Heritage.

Science: Planet Earth and Beyond and Living World.

Health and Physical Education: Healthy Communities and Environments.

Technology: Technology and Society.

English and Mathematics: All of the activities can be linked into these curriculum areas.

The Arts: Developing Ideas in the Arts and Communicating and Interpreting in the Arts.

Possible learning examples

Science – *Making Sense of the Living World*

Students could be learning by:

Level 1 1.1 – Reading books about the main features of wetland animals and plants.

1.2 – Visiting a wetland and observing the different plants and animals that live there.

Level 2 2.1 – Looking at the differences between fish, birds, insects and plants you found in a wetland.

2.4 – Finding out what happens to animals in wetlands when their environment is damaged.

Level 3 3.2 – Visiting a wetland to observe the special features of plants and animals that enable their survival in this habitat.

3.3 – Researching why wetland species such as weka, kokopu, mudfish etc. have become endangered.

Level 4 4.1 – Investigating and classifying the fish that whitebait grow into.

4.4 – Researching and examining some of the solutions to pollution in wetlands.

Level 5 5.2 – Describing adaptations that help animals and plants survive in a wetland environment.

5.4 – Drawing an energy pyramid for a wetland ecosystem.

Level 6 6.1 – Using wetlands from around the world look at the use of helpful micro-organisms in modern medicine.

6.4 – Investigating the management of a wetland revegetation programme.

Level 7 7.1,2,4 – Collecting data and writing a report on humping and hollowing of the land for dairy farming. Investigating the effect on the diversity of the plants and animals.

Social Studies – *Place and Environment*

Students could be learning by:

Level 1 1.1 – Naming a wet place and saying why it is important eg. duck pond.

Level 2 2.2 – Finding out why different people perceive wetlands differently eg. farmers, duck shooters and whitebaiters.

Level 3 3.1 – Writing a play showing how wetland users utilise a wetland for different purposes, without damaging the environment.

Level 4 4.1 – Identifying landscape features that have changed at a wetland because of people's past activities.

Level 5 5.2 – Using Māori culture, explain why wetlands are important to people.

Level 6 6.1 – Planning and implementing a restoration project for a wetland.

Level 7 7.2 – Investigating the role that the Department of Conservation, West Coast Regional Council, the District Councils, Fish and Game, Forest and Bird, Ngai Tahu's Kaupapa Taio Unit etc. have had on changing people's perceptions of wetlands.

Level 8 8.1 – Creating a strategy to help people overcome conflicting ideas on wetland usage.

RAMSAR CONVENTION

The Ramsar Convention is the only treaty focusing on one type of ecosystem: wetlands. In 1971 eighteen countries worked together to create the Convention. It came into force in 1975 and New Zealand joined in 1976. The Convention's mission is:

. . . the conservation and wise use of wetlands by national action and international co-operation as a means to achieving sustainable development throughout the world.

The Wetlands Convention is celebrated by World Wetlands Day, on the 2nd February each year. This date marks the anniversary of its signing on 2nd February 1971 in the Iranian city of Ramsar.

There are 1267 sites worldwide designated for the Ramsar List of Wetlands of International Importance. Currently there are 136 contracted parties to have signed the Convention.

New Zealand currently has five sites designated under the Convention. They are Waituna Lagoon in Southland, Farewell Spit in Nelson, Whangamarino, Kopuatai Peat Dome and Firth of Thames all in Waikato. More sites are likely to be nominated in the future, including some on the West Coast.

For further information on the Ramsar Convention visit www.ramsar.org

SAFETY

When planning a visit to a wetland make sure school policies and the correct procedures are followed. You will need to prepare a risk analysis management plan. Helpful documents include:

Education Outside the Classroom: Guidelines for Best Practice (1995) Ministry of Education.

Managing Risks in Outdoor Activities (1993) Mountain Safety Manual 27.

Outdoor Pursuits Guidelines for Educators (1996) Hillary Commission.

Water Safety Across the Curriculum (2000) Water Safety New Zealand.

Try the "Be Prepared" activity on the next page, which aims to help you and your class plan a safe trip together.

Before you visit sites you may like to check the environmental care code on DOC's website: www.doc.govt.nz/Explore/NZ-Environmental-Care-Code.asp

BE PREPARED ACTIVITY

One of the most important risk minimisation strategies you can undertake is to involve the students in this aspect of planning. Here is an activity for you to try.

1. Locate the wetland you are visiting. Use maps and practise grid references and compass directions.
2. Plan the trip. Still working with the map, guess (or calculate) how long it would take to get there. How will you travel there?
3. What kind of place or environment is it? Has anyone in your class/group been there before? Brainstorm what students already know about the site you are visiting.
4. Think about danger and safety. As a class, or in small groups, tell the students to look at their list or picture of the site and think of dangers to themselves and their classmates. For every danger, see if they can think of a way to make it safe. For example:

DANGER/RISK!	KEEPING ME SAFE!
Being poked in the eye/ear with a stick	Watch for low branches
Getting cold and wet	Take warm, waterproof clothes
Sinking into the mud	Follow the groups leader carefully

EXTRA: As a follow up, students could design a safety coat with lots of features like; being waterproof, pockets for things so that your hands are free, becomes inflatable in case you fall in the water, has a survival kit in case of accidents or getting lost.

5. Think about the safety of the environment or place you are visiting, especially the impact the students will have on the environment. Ask students to go back to their original list or picture of the site and think about how they can be a danger to the environment and what they can do about it. Make a list similar to the one above.

MY IMPACT ON THE ENVIRONMENT	HOW I CAN STOP IT
Disturbing the wildlife	Don't shout or scream
Trampling plants	Watch where I put my feet
Breaking twigs of trees and plants as I walk past	Don't damage any of the plants
Dropping litter	Put wrappers in my pocket, pick litter up

NOTES: If the site you are visiting is a Māori historical site (middens, archaeology, pa sites), it will be of special significance and this should be included in your discussions.

Further reference material for planning trips is available from the New Zealand Mountain Safety Council Inc. NZMSC, Box 6027, WELLINGTON

NEW ZEALAND ENVIRONMENTAL CARE CODE

Protect plants and animals

Remove rubbish

Bury toilet waste

Keep streams and lakes clean

Take care with fires

Camp carefully

Keep to the track

Consider others

Respect our cultural heritage

Enjoy your visit

Toitu te whenua (Leave the land undisturbed)

PRE VISIT ACTIVITIES

- Be Prepared activity (see previous page).
- Brainstorm 'what is a wetland? Make up a definition. Revisit after your fieldtrip and see if you still agree.
- Make up banners for your classroom using Wonderful Wetlands, Special Streams, Excellent Estuaries and Choice Coasts (refer to the final section of this resource).
- (i) Using the posters make a list of all the users and uses of wetlands. Divide them into harmful and not harmful to wetlands. Revisit this activity at the end of the unit to see if any changes need to be made.

  (ii) Divide the users and uses into 3 categories: recreational, economic and conservation activities.

  (iii) What do you think will happen if one of these user groups, over a period of 20 years, dominated the others?
- Collect historical information about the wetland you are going to visit. It may help to identify changes to the wetland.
- Create a mural of a wetland along your classroom wall. Add in details such as plants, insects, birds etc. as you learn about them.
- Visit the environmental education section on the Christchurch College of Education website. Play 'Making the Links'. Include topics such as: infilling of wetlands, loss of native species, water quality, wildlife, weed invasion, tourist development, eutrophication, loss of scenic areas, soil salinity etc. www.cce.ac.nz/enved/
- As a class generate a list of all the places you are likely to find water within 20 kms of your school (allow for places such as bath, sink as well as river, pond, sea etc.). In another list name the wildlife you may find. Review this list after your study.
- Examine the roles of people who work in or help to look after natural areas. Who are they? What do they do?
- Find out what the students know about DOC.
- Is there a DOC office in their area? What sorts of things does a DOC ranger do? Check out the DOC web site www.doc.govt.nz

POST VISIT ACTIVITIES

- Revisit the activities you did before your fieldtrip. Make any changes needed.
- (i) Brainstorm 'actions that people can take to protect wetlands.' Encourage students to think about agencies who can be involved eg. DOC, District and Regional Councils, Fish and Game, Forest and Bird, Ducks Unlimited NZ, Ngai Tahu's Kaupapa Taio Unit.

  (ii) Invite a representative from one or more of these agencies to visit your class/ group. Prepare a series of questions to facilitate a discussion on wetlands in general or for a specific issue.
- Adopt a wetland and arrange for your school to become guardians (kaitiaki) of this area. Plan regular rubbish clean ups, planting of native plants etc.
- Develop a strategy to help change people's behaviour and attitudes to promote the protection of wetlands. Designing posters may be a good first step. Ask your local library, DOC office or council to display them.
- Write a short book, create a PowerPoint presentation or a Kid Pix slideshow titled "All about Wetlands."
- Make a poster/s related to wetlands. Topics could be: Wetlands on the West Coast, Biodiversity of Wetlands, Wetland Ecosystems, Users and Uses of Wetlands, Protection of Wetlands.
- Construct a mobile of a food chain or food web.
- Write a song/rap about the importance of wetlands.
- Create a restoration plan for a wetland and write an explanation.
- Create some poetry. It may be about your experiences at the wetland, the value of wetlands, what your senses picked up or focus on a plant or animal.
- Research a wetland plant or animal and share your information in a report or poster (it may be one you did or did not see on your field trip).
- Write a story about 'A day in the life of a _____ ' (banded kokopu, trout, mallard, whitebait etc).
- Make a "wanted" poster for an introduced pest (plant or animal). Describe the damage that the pest is doing and suggest an ecological reward for its elimination.
- Make a poster about *Native Fish: The Well-kept Secret of our Streams and Swamps*. Add eels, mudfish and bullies. Find out why they become rare when streams are polluted, dammed and stripped of surrounding trees.
- Develop statements about natural and social events that might affect a wetland in the future. Have others rate these statements on a scale of 1 – 5, giving reasons for their answers. This information may be used to develop an action-orientated activity that looks at the range of attitudes and values expressed.

- Play The 'Webbing Game.'

  This is a good activity that illustrates clearly how organisms in a wetland habitat are dependent on one another. For this activity you will need a long piece of string or wool and some sticky labels.

RULES:

1. Each student wears a label with the name of a wetland plant or animal on it.
2. Use the string to join together the organisms that share a feeding relationship – eaters are joined with the eaten.
3. Think up some scenarios that would affect a food chain. For example at Tuckers Flat someone dumps harmful waste into the water. This damages the plants. Each time an example is given, the organism that is affected tugs on the string. Anyone else who feels the tug also tugs.

   Discuss with the students what happens to the rest of the community when one directly affected organism tugs on the string.

Fact Sheets

WHAT IS A WETLAND?

Wetlands is a collective term for permanently and intermittently wetland, shallow water and land-water margins. Wetlands may be fresh, brackish or saline and are characterised in their natural state by plants or animals that are adapted to living in wet conditions.

New Zealand Wetlands Management Policy (1986)

- Wetlands act like giant sponges. They absorb water during heavy rain or snow melt and release the water gradually. This reduces flooding and maintains downstream water flows and ground water levels during periods of low rainfall.
- Wetlands are important for improving water quality. They are able to directly improve other ecosystems by absorbing many of the impurities that flow into the wetland. Their role is similar to that of our kidneys – they both help control water flow and cleanse the system.
- Wetlands support the greatest concentrations of bird life of any habitat in New Zealand. Wetlands make up 2% of New Zealand's land area but 22% of our bird species can be found in a wetland habitat.
- Wetlands are very productive environments supporting a diversity of species. An enormous range of plants inhabit wetlands and a number of New Zealand's endangered plant species are totally dependant on wetlands for their survival.
- Wetlands on the West Coast vary greatly. There are permanent and temporary wetlands with fresh, stagnant, brackish or salty water. Sometimes the water is flowing and other times it is still.
- The most common wetland classes on the West Coast are bogs, pakihis, swamps, lakes, rivers, lagoons and estuaries.
- Typical West Coast wetland plants include (refer to appendix 1 for an extensive list):
    - Jointed wire rush (estuary)
    - Flax / harakeke (swamp)
    - Bulrush / raupo (swamp)
    - Cabbage tree / tī kouka (swamp)
    - White pine / kahikatea (swamp)
    - Wire rush (bog/pakihi)
    - Sphagnum moss (bog)
    - Manuka (bog/pakihi)

Cabbage tree / tī kouka

- Characteristic wetland insects include (refer to appendix 5 for an extensive list):
    - Damselflies and dragonflies (lakes)
    - Moths (swamps/bogs)
    - Mayflies (streams)
    - Caddisflies (streams)
    - Sandflies / namu and mosquitos / waeroa

Dragonfly nymph

Pūkeko / pākura

Longfin eel / tuna

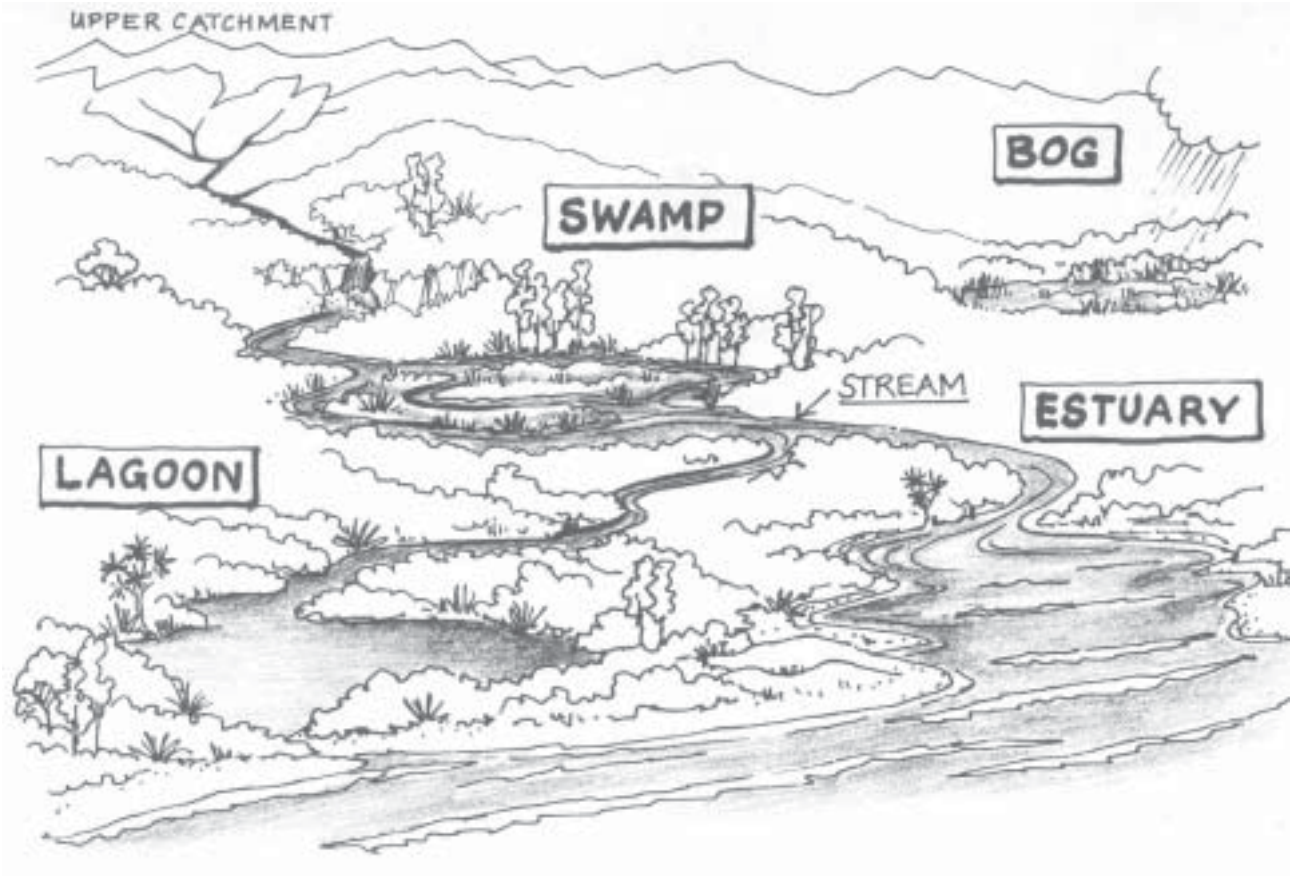
- Typical wetland birds include (refer to appendix 2 for an extensive list):
  - Ducks
  - Herons and egrets
  - Shags / kawau
  - Pūkeko / pākura
- Common wetland fish include (refer to appendix 3 for an extensive list):
  - Longfin eel / tuna
  - Whitebait / inanga
  - Mudfish / waikaka / hauhau

TYPES OF WETLANDS

- There are a variety of wetland types.

  For a more comprehensive list see appendix 10.

- Wetlands can be divided into these two main categories: *inland* and *coastal.* We are focusing on these *inland* wetlands: swamps, bogs and streams and these *coastal* wetlands: estuaries and lagoons.



Bogs and Pakihis

The terms bog and pakihi are often confused when describing and naming wetlands.

Bogs are fed by rain water. They often form in basins on level or gently sloping ground. Bogs usually have spongy peat soils, acidic water and a floor covered by sphagnum moss. A bog is nutrient poor as there are few nutrients in rain water. This combination means vegetation that lives there needs to be highly specialised (see diagram on page 20). Okarito pakihi is an example of a bog.

Pakihis may often look like bogs and they contain similar vegetation types, but they lack peat, developing instead from poorly drained mineral soils. Pakihi soils are also fed by rain water, are acidic and are low in nutrients. Stafford pakihi near Kumara is a good example of a pakihi.

Swamps

Swamps are fed by streams or lakes as well as rain water and ground water. Streams carry nutrients and sediments and the current means these nutrients are distributed around the swamp. The water level in swamps fluctuates but swamps are usually permanently wet eg. Birchfield swamp in Buller.

Lagoons

Lagoons are occasionally opened to the sea so they receive both freshwater and saltwater. The salinity of the water varies depending on how frequently the lagoon mouth is opened and salt water enters. There is often a wide variety of flora and fauna because of these conditions eg. Saltwater Lagoon in South Westland.

Estuaries

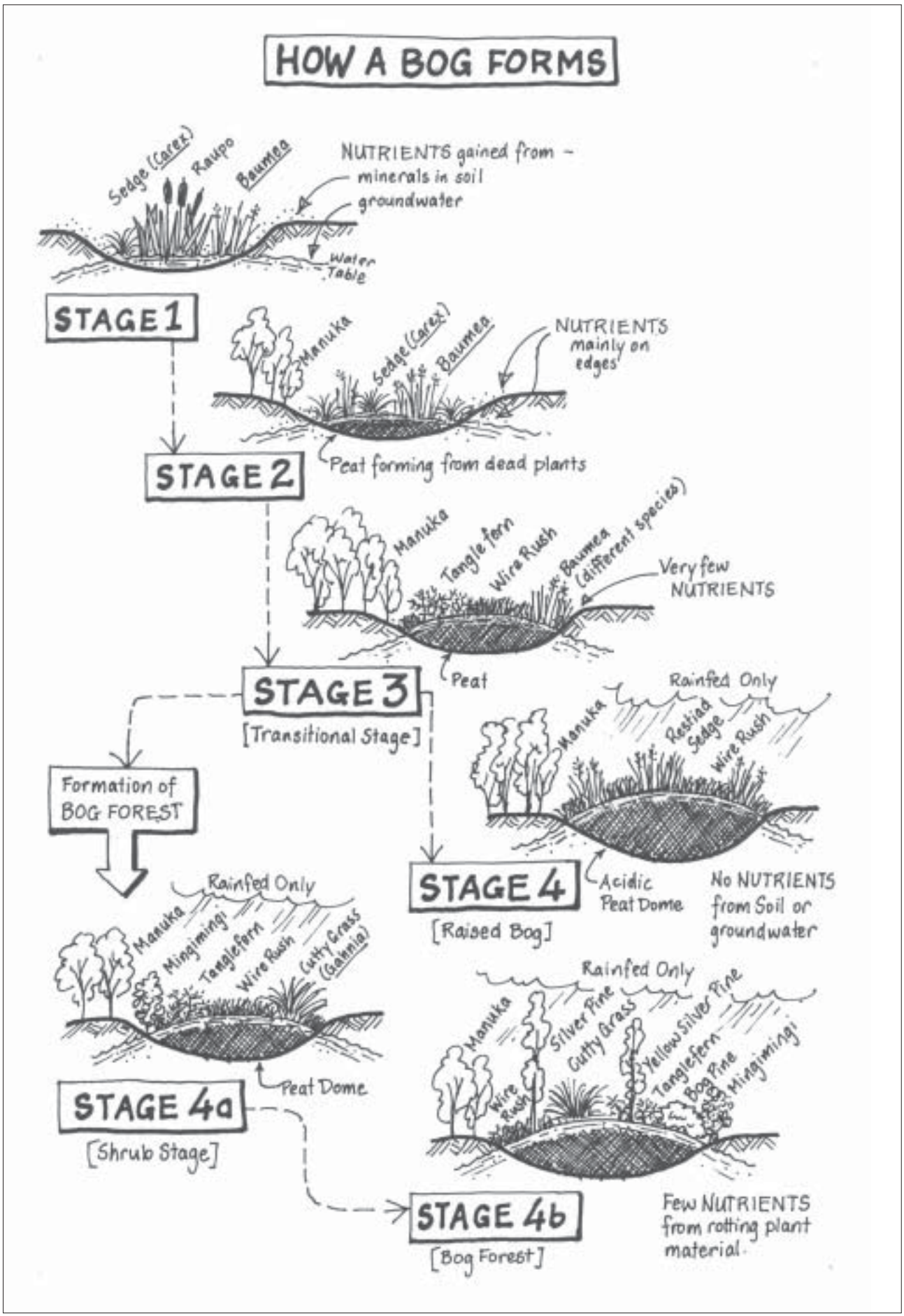
Estuaries are partially enclosed coastal areas where sea water mixes with freshwater from a river. They may be salty or brackish and the water level fluctuates depending on the tide. Estuaries often have intertidal mudflats. These mudflats are usually very productive and support specialised plants and provide a spawning ground for fish eg. Hapuka estuary in Haast.

HOW WETLANDS CHANGE OVER TIME

- All wetlands naturally pass through stages of growth, erosion and infilling.
- Many wetlands are permanent while some are only formed during heavy rainfall.
- The nutrient status and the types of plants and animals present help determine the stage and age of wetlands.
- The following table summarises the evolution of a lake with Tuckers Flat used as a example:

STAGE	NUTRIENT VALUE	PLANT LIFE	BIRD LIFE
Young	Low	- Few submerged plants - Few marginal plants	- Few species - Small numbers
Middle Aged	Moderate	- Many submerged plant - Lake becoming shallower - Many marginal plants - Plants healthy	- Large numbers - Birds breeding - Many species 
Aged	High	- Excessive growth of submerged plants	- Low numbers - Less diversity of habitat (less open water) - No breeding 

- Wetlands also change by appearing or disappearing with earthquakes, land slides or floods.
- As soon as ground water flow stops because of rising ground, the wetland becomes reliant on rainwater. This changes the amount of nutrients the wetland receives and in the long term the types of vegetation that grow.
- The following picture show how a bog forms on the West Coast; stage 2 is sometimes referred to as a "fen".


HOW A BOG FORMS
Sedge (Carex)
Raupo
Baumea
NUTRIENTS gained from –
minerals in soil
groundwater
Water Table
STAGE 1
Manuka
Sedge (Carex)
Baumea
NUTRIENTS mainly on edges
Peat forming from dead plants
STAGE 2
Manuka
Tangle fern
Wire Rush
Baumea (different species)
Very few NUTRIENTS
Peat
STAGE 3
[Transitional Stage]
Formation of BOG FOREST
Rainfed Only
Manuka
Restiad Sedge
Wire Rush
STAGE 4
[Raised Bog]
Acidic Peat Dome
No NUTRIENTS from Soil or groundwater
Rainfed Only
Manuka
Mingimingi
Tanglefern
Wire Rush
Cutty Grass (Gahnia)
Peat Dome
STAGE 4a
[Shrub Stage]
Rainfed Only
Manuka
Silver Pine
Cutty Grass
Yellow Silver Pine
Tanglefern
Bog Pine
Mingimingi
Wire Rush
STAGE 4b
[Bog Forest]
Few NUTRIENTS from rotting plant material

THREATS TO WETLANDS

- In New Zealand we have less than 10% of our original wetlands. This is because wetlands naturally occur in lowland areas that make good farmland, ports, towns and cities if drained or filled in.
- This table shows how New Zealand compares to Australia and the USA.

Country	% of original wetland area destroyed
New Zealand	90%
Australia	50%
United States of America	Most states have lost about 60%

- On the West Coast we have only 25% of our original wetlands.
- This table shows how the West Coast compares to other regions in New Zealand.

New Zealand regions	% of original wetland area destroyed
Bay of Plenty	99%
Waikato	85%
South Canterbury	75%
West Coast	75%
Southland	73%

Source: Cromarty, P. (1996) *A Directory of Wetlands in New Zealand.*

- Human activity such as these examples are the biggest threat to wetlands:
    - o expansion of urban settlements;
    - o extraction of sand and gravel;
    - o reclamation of estuaries, lagoons, lake shores and river margins;
    - o drainage of swamps on farm land;
    - o humping and hollowing;
    - o drainage to plant exotic forests;
    - o fire;
    - o enriched run-off from fertilisers, animal waste and effluent from silage pits, sewage ponds and septic tanks;
    - o invasion of weeds and animal pests;
    - o grazing by stock;
    - o lowered water levels because of drainage of surrounding land;
    - o removal of natural riparian vegetation from wetland edges;
    - o poorly placed culverts that prevent migration of native fish upstream;
    - o poorly managed recreational usage;

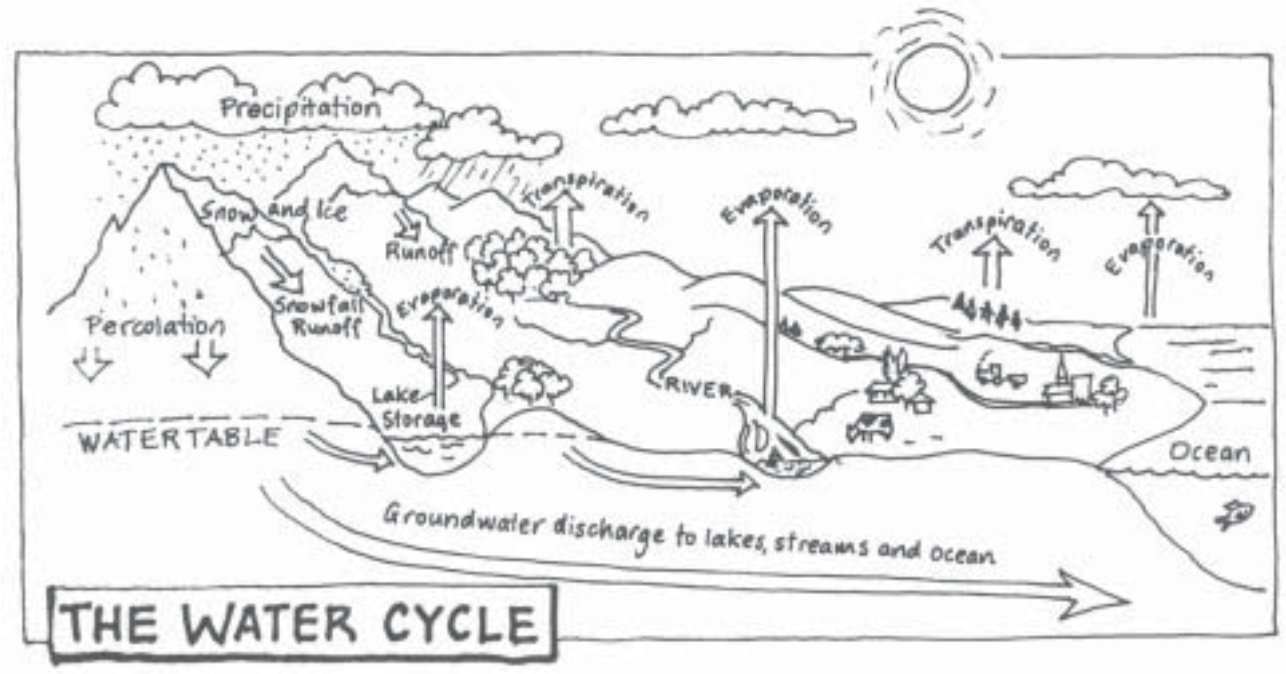
- over extraction of resources eg. sphagnum moss;
- sediment build up in estuaries from more soil being washed into the waterways because of deforestation and stock-trampled river banks, and
- the human mindset that wetlands are of no importance to us and are an eye-sore.

- Wetlands have become scarce and are one of our most threatened ecosystems in New Zealand.

WETLAND USES & USERS

- Wetlands are important because they have a variety of uses and users.
- They:
    - provide homes and breeding grounds for a large number of plants and animals, including some that are threatened;
    - help stabilise water levels during flooding (coastal and inland);
    - help clean 'dirty' water;
    - retain and export sediments and nutrients;
    - provide fishermen, hunters, naturalists and those who enjoy water sports such as swimming and boating a place to enjoy their hobby or sport;
    - provide excellent examples of ecosystems and natural processes;
    - often contain historical and cultural values;
    - are a traditional source of food (mahika kai) for māori;
    - can be used for grazing;
    - attract tourists to see birds or scenery;
    - produce economic resources such as sphagnum moss, eels, whitebait, coal, peat and flax, and
    - can be used to treat effluent and discharged chemicals.
- Managing wetlands is important so that conflict is minimal between:
    - farmers;
    - conservationists;
    - tourist operators;
    - tangata whenua;
    - land developers;
    - scientists, and
    - recreationists.

THE WATER CYCLE IS IMPORTANT FOR WETLANDS

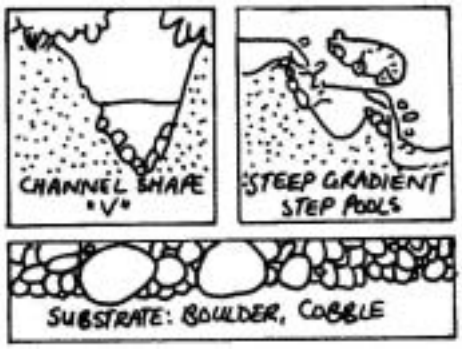


SOURCE: *Whitebait Connection Manual*

- The water cycle begins with rain or snow falling in the mountains. The snow eventually melts (this may take years as it could be trapped in glaciers) and with the rainwater it flows into small streams and then to lakes and rivers. Some water sinks (percolates) into the earth to become groundwater. This may reappear later as springs.
- Rain is also soaked up into the soil. Plants take up this water and release it back into the atmosphere through plant transpiration. Water evaporating from rocks, lakes etc. is also released into the atmosphere.
- Freshwater in streams and rivers will eventually flow out to sea. Groundwater also ends up in the sea but the process is much slower.
- Water evaporates from the ocean's surface. As water vapour rises and builds up it forms clouds. These are blown towards land and when it is cold enough the water vapour is released as rain (precipitation) . . . and the cycle begins again.
- When water vapour condenses into a liquid it becomes a usable and vital resource.
- The water cycle is an essential part for the survival of wetlands and the land surrounding them. Wetlands act like giant sponges. They absorb water during heavy rain or snow melt and release the water gradually reducing flooding and maintaining downstream water flows.

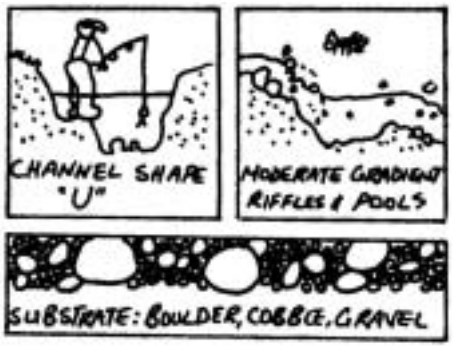
CATCHMENTS

- A catchment is a basin shaped area of land bounded by natural features such as hills or mountains from which water from the sky or ground flows into streams, rivers and wetlands.
- No catchment is exactly alike. Each has a different size, shape, drainage pattern and features that are determined by natural process such as climate and geology.
- There are usually 3 catchments each with its own purpose. They are:



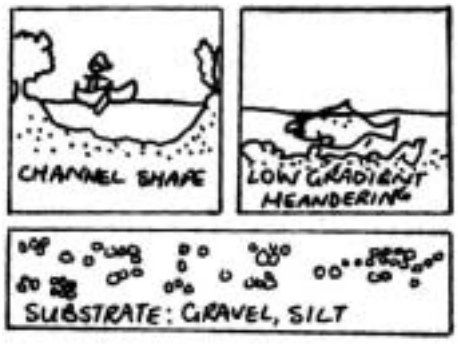
Upper catchment

Streams coming from the upper catchment maybe permanent, intermittent or appear only briefly. In the upper reaches streams tend to be narrower and vegetation at the water's edge (riparian) almost completely covers the stream with its canopy. Very little sun reaches these points, so the water remains cool throughout the year. Rocks, pebbles and bedrock are the common stream bed material of the fast flowing headwater streams in the upper catchment. Moss, invertebrates and fish are common up here. The headwaters are very important to the health of the entire system as the food sources here flow downstream.



Middle catchment

By the middle section other tributaries have entered the stream to increase the flow. The land is often flatter with the stream flow slowing. Streams here often flow in curves and meander across floodplains. The canopy no longer shades the entire water surface so the sun is able to warm the water. Organic debris still fall into the streams from the riparian zone but with the increased light, algae become an important part of the food base.



Lower catchments

More tributaries have entered and more flow has been added. The streams here travel very slowly and deposit large quantities of sediment picked up from upstream. The water is not shaded by vegetation here, but because the water is often murky penetration of heat from sunlight is limited. The level of spread of atmospheric oxygen is reduced in the surface water. This affects the breakdown of organic matter and the types of organisms that can tolerate lower oxygen levels. At the mouth of the stream it empties into a lake or an estuary. The quality of this water is affected by the sediment and debris that the stream is carrying.

Adapted from: *Whitebait Connection Manual* (2001)

What is a CATCHMENT?

Rocks & gravel are eroded by the steep headwaters and carried downstream.

Thick bush-cover in valleys keeps water cold.

Plenty of waterfalls.

As land becomes less steep, water slows down, dropping rocks + gravel to form floodplains.

River channel changes course often, meandering over floodplain.

Less bush cover: water warms up

Tributaries feed in

Rapids keep water churned up.

Wide, fertile floodplain (sometimes swampy)

Slow, warm water is not churned up by rapids or waterfalls, so has less oxygen in it.

UPPER CATCHMENT

Water is —
- > SWIFT
- > COLD
- > Loaded with COARSE sediment

MIDDLE CATCHMENT

Water is —
- > Moderately swift
- > COOL
- > Dropping coarse sediment

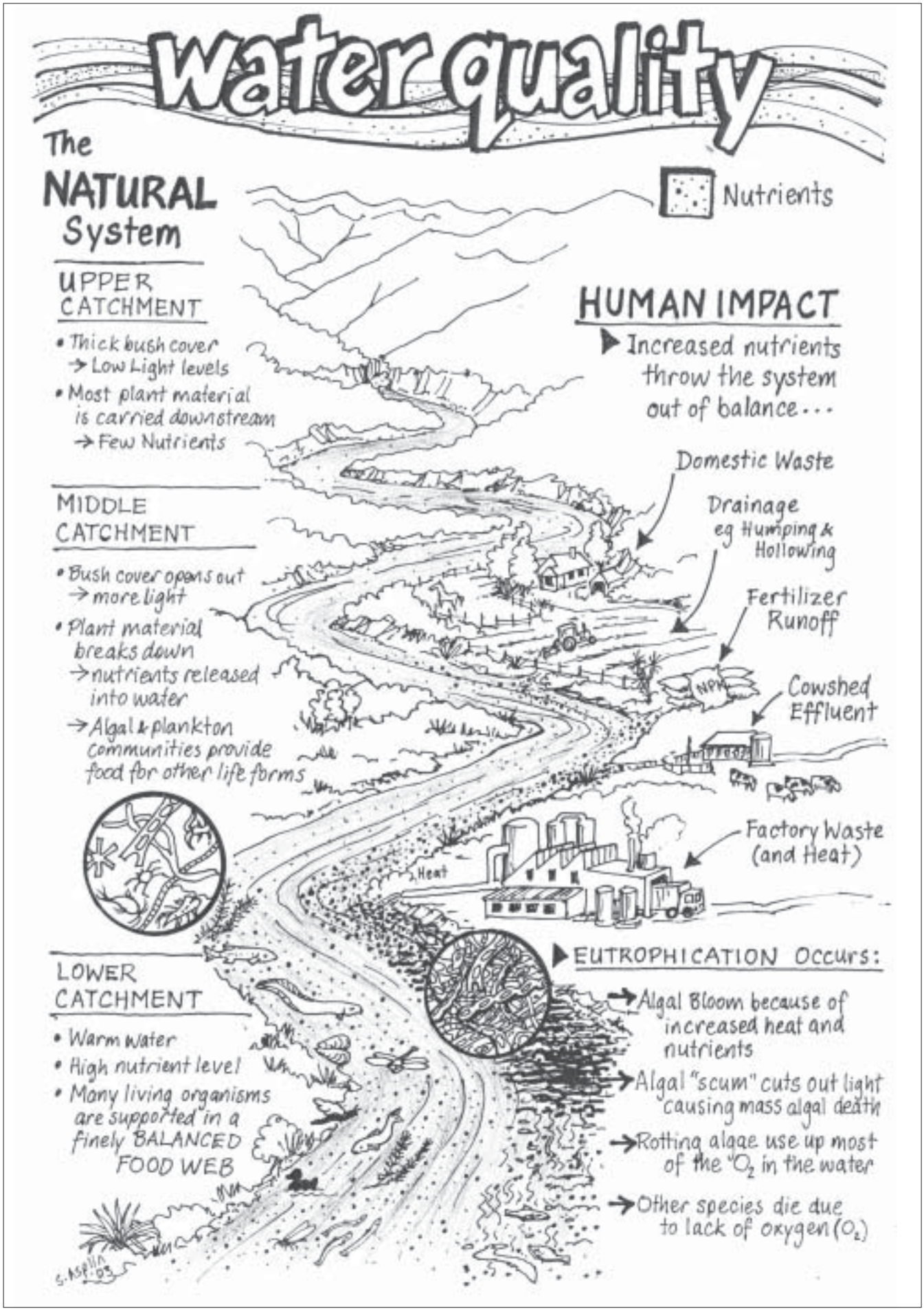
LOWER CATCHMENT

Water is —
- > SLOW
- > WARM
- > Dropping FINE sediment

WATER QUALITY

(See diagram over page)

- In their natural condition streams are very pure at the top of the catchment. As the stream flows downhill, generally light and temperature increases causing a planktonic system to develop.
- The plants growing in wetlands filter out solids, absorb nutrients and add oxygen to the water. If nutrients enter the stream too quickly the system is quickly altered and the balance broken.
- As the situation worsens eutrophication (over supply of nutrients resulting in high algae growth, low oxygen levels causing stream life to deteriorate) occurs. This can be fatal to many freshwater invertebrates.
- Poor water clarity has a direct effect on fish and birds that rely on their sense of vision to find and catch their prey.
- We can minimise reduction or loss of water quality in the following ways:
    - Create 'buffer zones' around the edges of the wetlands. These are strips that contain natural vegetation, 5-20m wide and fenced to protect from grazing animals.
    - Slowing stormwater run-off from urban areas by using 'natural' systems such as grassed swales (drainage channels).
    - Controlling stormwater run-off from areas of disturbed land using sediment traps, silt fences or rock filters.
    - Avoid discharge of pollutants into waterways from poor 'housekeeping' practices – these are things like used oil, unused paint, detergents and wastewater disposal.
    - Put in structures that slows down the water from stormwater pipes entering natural streams.


water quality
The NATURAL System
Nutrients
UPPER CATCHMENT
• Thick bush cover → Low Light levels
• Most plant material is carried downstream → Few Nutrients
HUMAN IMPACT
▶ Increased nutrients throw the system out of balance...
Domestic Waste
Drainage eg Humping & Hollowing
Fertilizer Runoff
Cowshed Effluent
Factory Waste (and Heat)
MIDDLE CATCHMENT
• Bush cover opens out → more light
• Plant material breaks down → nutrients released into water
→ Algal & plankton communities provide food for other life forms
Heat
LOWER CATCHMENT
• Warm water
• High nutrient level
• Many living organisms are supported in a finely BALANCED FOOD WEB
▶ EUTROPHICATION Occurs:
→ Algal Bloom because of increased heat and nutrients
→ Algal "scum" cuts out light causing mass algal death
→ Rotting algae use up most of the O_2 in the water
→ Other species die due to lack of oxygen (O_2)

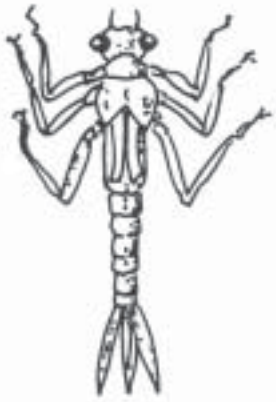
INVERTEBRATES

- Invertebrates (larvae and adults) are a vital part of the freshwater ecosystem. They include *predators* eg. dragonflies; *grazers* eg. mayflies; *shredders* eg. caddisflies and *filterers* eg. stoneflies. Many invertebrates are able to fill more than one group depending on the type of food available.
- Many of them feed on plant matter (algae, leaf litter and aquatic 'weeds') and also provide the most important food source to New Zealand freshwater fish.
- Without invertebrates we would have no native eels, bullies or whitebait species, and no introduced trout, salmon or perch in our freshwater habitats.
- Invertebrates can tell us a great deal about how healthy the water way is. Many species indicate clean water, cool temperatures and generally natural conditions.

  Eg. stoneflies, mayflies, craneflies, some caddisflies and horse hair worms are some of the many invertebrates that indicate **good** water quality.
- Water boatmen, back swimmer, pond snails, flat worm, rat-tailed maggots, mosquito larvae, sandfly larvae and midges are common in pools of swampy areas.
- A stream which lacks any invertebrate life has a major habitat problem, possibly because of recent pollution or drying of the streambed.
- Some of the invertebrates you may see:

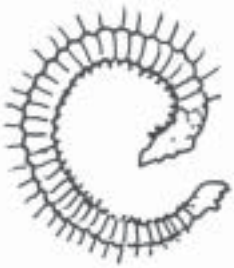
Mayfly

Water boatman



Dragonfly nymph

Caddisfly larvae



Aquatic worm

Pond snail

For further information: *A Photographic Guide to the Freshwater Invertebrates of New Zealand* (1997). Otago Regional Council.

WETLAND SOILS

Two common freshwater wetland soils on the West Coast are peat and gley soils:

Peat *(organic soil)*

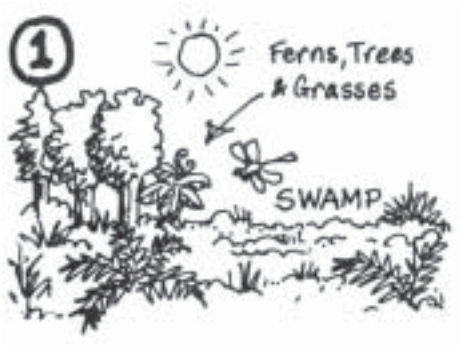
- Peat is the build up of partially decomposed plants. Major peat formers are plants like Sphagnum and Empodisma (wire rush).
- Forms under conditions such as constant wetness, absence of oxygen and a cool climate.
- Due to lack of oxygen dead plant material is not decomposed by fungi and bacteria. Instead it accumulates as peat, often to depths of many metres.
- If the soil contains approximately 50% organic matter or more, it is considered to be peat.
- Peat bogs are relatively infertile.
- Over millions of years, with downward pressure being applied to the peat it will eventually change into coal (for further information see the section on coal).

Gley podzols

- Gley podzols are mostly formed from broken down rocks and minerals.
- These soils are not necessarily under constant wetness. They are often associated with seasonal waterlogging or flooding.
- Occur in regions where rainfall is above 2200mm per annum. The West Coast is the only place in New Zealand where they are found extensively. These soils occur by strong leaching (the removal of nutrients from the soil by water) and long periods under acidic water.
- Some gley podzols remain under native forest but most are found on wet terrace land under 'pakihi' vegetation; wire rush, tangle fern, sphagnum moss and manuka.

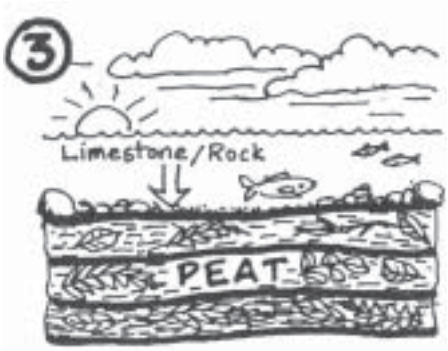
In coastal wetlands, the substrate can be ***sand*** or ***mud***.

DID YOU KNOW THAT COAL FORMED FROM SWAMPS?

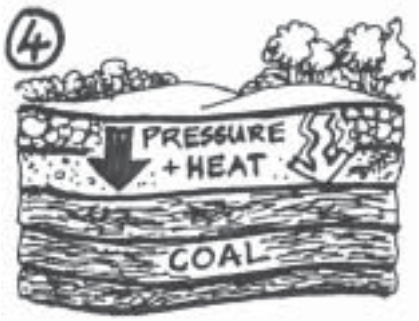


More than 250 million years ago, forests of gigantic trees, ferns and grasses covered vast swamp lands and stored up energy from the sun.

When the giant forests died, they rotted forming vegetable matter called peat. For thousands of years, plants grew, died and formed layer upon layer of peat.



Later, when the surface of the earth changed, seas covered the land and deposited layers of limestone and other rock on the peat.



When the seas retreated, heat and pressure from the layers of rock changed the peat into coal.

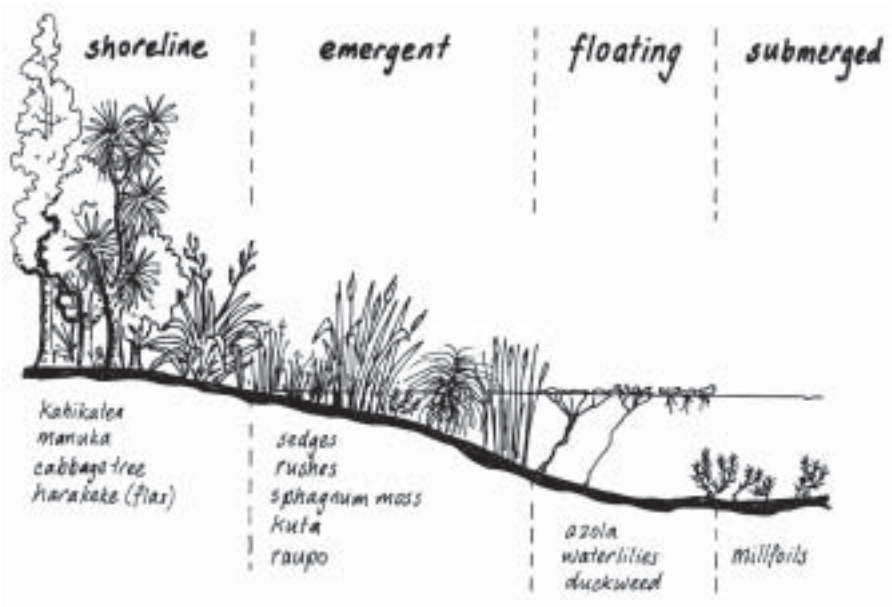
SOURCE: adapted from: http://www.coaleducation.org

WETLAND PLANTS

- Wetlands contain a huge diversity of plants, with many wetland plants having the special ability to grow in waterlogged soils of poor quality.
- The most common native wetland plants found are the following (for a more comprehensive list see Appendix 1):

PLANTS	WETLAND FOUND IN
Sedges / eg. papao, rautahi (Carex species)	Swamp
Bulrush / raupo	Swamp
Rushes (Juncus species)	Swamp
Coprosma shrubs eg. karamu	Swamp
White pine / kahikatea	Swamp
Flax / harakeke	Swamp
Cabbage tree / ti kouka	Swamp
Cutty grass	Swamp,bog
Tea tree / manuka	Bog
Pakihi rush (Baumea species)	Bog
Sphagnum moss	Bog
Sundews	Bog
Tangle fern	Bog
Wire rush	Bog
Pondweed and milfoil	River, lake
Ribbonwood / manatu	Estuary
Jointed wire rush / oioi	Estuary
Sea primose / maakoako	Estuary
Selliera / remuremu	Estuary

- At a wetland different plants live in different communities. These are defined by the level of water. In lakes and ponds the four communities/zones are:



Submerged – plants growing under the water eg. milfoils, pondweed.

Floating – plants with leaves that float on the water eg. duckweed, water lilies.

Emergent – plants with their roots in shallow water but with stems and leaves exposed eg. sedges, rushes, sedges, sphagnum moss

Shoreline – plants growing on dry land but near the water's edge eg. kahikatea, harakeke, manuka.

WETLAND FISH

- New Zealand has 35 native fish species and 21 introduced species.
- Almost 30% of our native fish live in wetlands
- 17 native fish species have a phase where they live in the sea. They need clear access to and from the sea. Dams, poorly placed culverts and pollution create barriers.
- Coastal estuaries are four times more biologically productive than our best pastures.
- New Zealand has four fish classed as a pest or noxious; gambusia (formerly called mosquito fish), koi carp, rudd and catfish. On the West Coast catfish is found but only in Lake Mahinapua.
- Catfish stir up sediment and prey on small native fish, fish eggs and koura (freshwater crayfish).
- The following fish are the main fish you are likely to find in West Coast wetlands.

Longfin eel/tuna
Native

Common bully
Native

Redfin bully
Native

Inanga
Native

Koaro
Native

Banded kokopu
Native

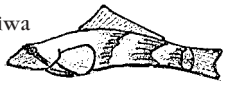
Smelt/paraki
Native

Giant Kokopu/taiwharu
Native

Shortjaw kokopu
Native

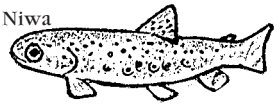
Brown mudfish
hauhau/waikaka
Native

SOURCE: Niwa



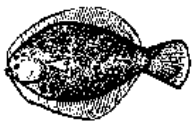
Torrent fish/piripiri pohatu
Native

SOURCE: Niwa



Trout
Introduced

Catfish
Introduced



Black Flounder/patiki
Native

Artist: Sonia Frimmel unless otherwise stated.

WHITEBAIT - WHAT ARE THEY?

- Lots of people enjoy the delicacy of whitebait. When caught, whitebait all look very similar, but they will usually grow up to be one of these five species of galaxiid; inanga (*Galaxias maculatus*), koaro (*G.brevipinnis*), banded kokopu (*G. fasciatus*), giant kokopu, (*G. argenteus*) and shortjaw kokopu (*G. postvectis*).
- Inanga, on the West Coast, make up almost 90% of the catch on average. Koaro and banded kokopu make up only 5% each, while giant and short jawed kokopu (both are considered under threat) account for less than 1%.
- All whitebait species that are not landlocked spend part of their life cycle in fresh water and part in the sea. For example inanga have the following life history:

a) They lay their eggs amongst the vegetation on the banks of estuaries or wetlands close to the sea. Eggs are laid during the spring tide at the end of summer and into autumn. Most inanga die after egg-laying. When the spring tide recedes the eggs are left to develop out of water where they are shaded and kept moist by waterside vegetation.
b) Tiny fish hatch and are carried out to sea during the following spring tide where they will live and grow over the winter.
c) During spring juvenile inanga (whitebait) swim back up rivers and streams.
d) They spend the summer feeding in a variety of freshwater habitats close to the coast. They like the water to be sheltered by trees and other waterside vegetation. By the end of summer they are mature and move back to the estuaries to spawn.

What adult whitebait look like

INANGA – Slender in shape these fish grow to approximately 10 cm long (longest recorded was 19cm). Their back and sides are olive green, but they have a bright silver belly and gill covers. These fish are found in wetlands, streams, rivers and lakes close to the sea. They feed mostly on insect larvae and other invertebrates. PHOTOGRAPH: Chris Pugsley

KOARO – Are tube like in shape and grow to approximately 18 cm (longest recorded was 28cm). The sides and back of koaro are covered in golden blotches and bands that glisten in the sun. They live in rocky streams in native forests or in lakes. They eat a variety of freshwater insects and crustaceans. PHOTOGRAPH: Stephen Moore

BANDED KOKOPU – They grow to approximately 18 cm (longest recorded was 26cm) and have thin vertical bands along their sides and back. This fish is found in pools in small bouldery streams and creeks that have an overhead canopy of vegetation. They eat aquatic invertebrates and land animals such as spiders and insects that have fallen into the water. PHOTOGRAPH: Stephen Moore

GIANT KOKOPU – This species can grow to 58 cm but are usually around 20-30 cm long. Their back and sides are covered in golden spots, lines, crescents and rings. It is shy and lives in slow moving or still water like lakes and swamps. This fish eats some land animals such as spiders and insects that have fallen into the water as well as aquatic insects and crustaceans. PHOTOGRAPH: Taranaki Regional council

S**HORTJAW KOKOPU –** Are approximately 15-20 cm long (longest recorded was 35cm) with a large black semicircular marking behind the head. This is the least common of all the whitebait species. It is shy and usually found in streams with large boulders and well forested stream banks. This fish feeds on aquatic invertebrates and land insects that have fallen into the water. PHOTOGRAPH: Dean Caskey

For further information: McDowall, R. M. (2000). *New Zealand Freshwater Fishes.* Reed Publishing, Auckland, New Zealand

WETLAND BIRDS

- Wetlands, both coastal and freshwater, support the greatest concentration of bird life of any habitat in New Zealand.
- New Zealand wide, wetlands make up less than 2% of our land area, but 22% of our bird species have wetlands as their main habitat. Many more birds use wetlands as a secondary habitat.
- Coastal wetlands support a large number of migratory birds. These birds travel from various places like Australia, Siberia and Alaska. For some, New Zealand is their breeding ground, while for others Siberia and Alaska is their breeding ground and New Zealand is where they feed to prepare for the long journey.
- Migratory species are very much dependent on chains of suitable wetlands. Coastal mudflats are favoured as they provide abundant food.
- During a 20 year life time, a long distance migrating bird would travel over 400,000 km.
- On the West Coast we have the only breeding ground in New Zealand for the white heron/kotuku. It is beside the Waitangiroto River near Okarito in South Westland. Adult birds start arriving from all over the country in August.
- Wetlands are the 'playground' for hunters from May onwards, depending on what is being hunted. Grey duck/mallard duck, shoveler duck/kuruwhengu, paradise shelduck/putakitaki, pukeko, black swan and Canadian geese are the species that are allowed to be hunted on West Coast.
- Birds use a variety of habitats within wetlands. Some prefer open water, other prefer the bushes around the edge or shallow water.
- The mallard duck, paradise shelduck/putakitaki and white-faced heron are some of the more adaptable wetland birds. They have coped with the changes to wetlands and now successfully exploit modified agricultural environments.
- Bird species that have specific wetland habitats such as the bittern/matuku, marsh crake/koitareke, fernbird/matata, blue duck/whio and the shoveler duck/ kuruwhengu have decreased in numbers as their wetland habitats have disappeared.
- Keeping a full range of wetland habitats, including areas of dense swampland is vital for the survival of many of our native bird species. Buffer zones that are fenced off around rivers and streams or paddocks is one thing that can be done to help protect wetland birds.

Common West Coast Wetland Birds

Pied Stilt

Found mainly on mudflats, but also feed in shallow water on wetland margins. Their cry is like the yelp of a puppy.

Pukeko

Feed mainly on plants and insects in swamps, on wetland margins, and on pasture. Flies mainly at night.

South Island Pied Oystercatcher

Black & white bird with long, red bill. Found in flocks on beaches & mudflats.

White Heron (Kotuku)

These solitary birds feed on small fish and baby eels in shallow water, on mud-flats & on swampy pasture.

Black Shag

Dives for fish in open water. Often seen on branches, drying it's wings.

White Faced Heron

Feed on small fish from mudflats and wetland margins. Self introduced from Australia in the 1940's.

Grey Duck

Feed on insects & weeds in shallow water. Also eats grasses and seeds from pasture.

South Island Fernbird

Small, shy, secretive bird, lives in swamps.

Scaup

Found on lagoons, lakes and coastal ponds. N.Z's only true diving duck. Newly hatched chicks can dive 2-3 metres!

FOOD CHAINS & FOOD WEBS

In any ecosystem such as a wetland, plants and animals depend on each other for survival. Soil, water, plants, and animals - including humans – rely on each other for food.

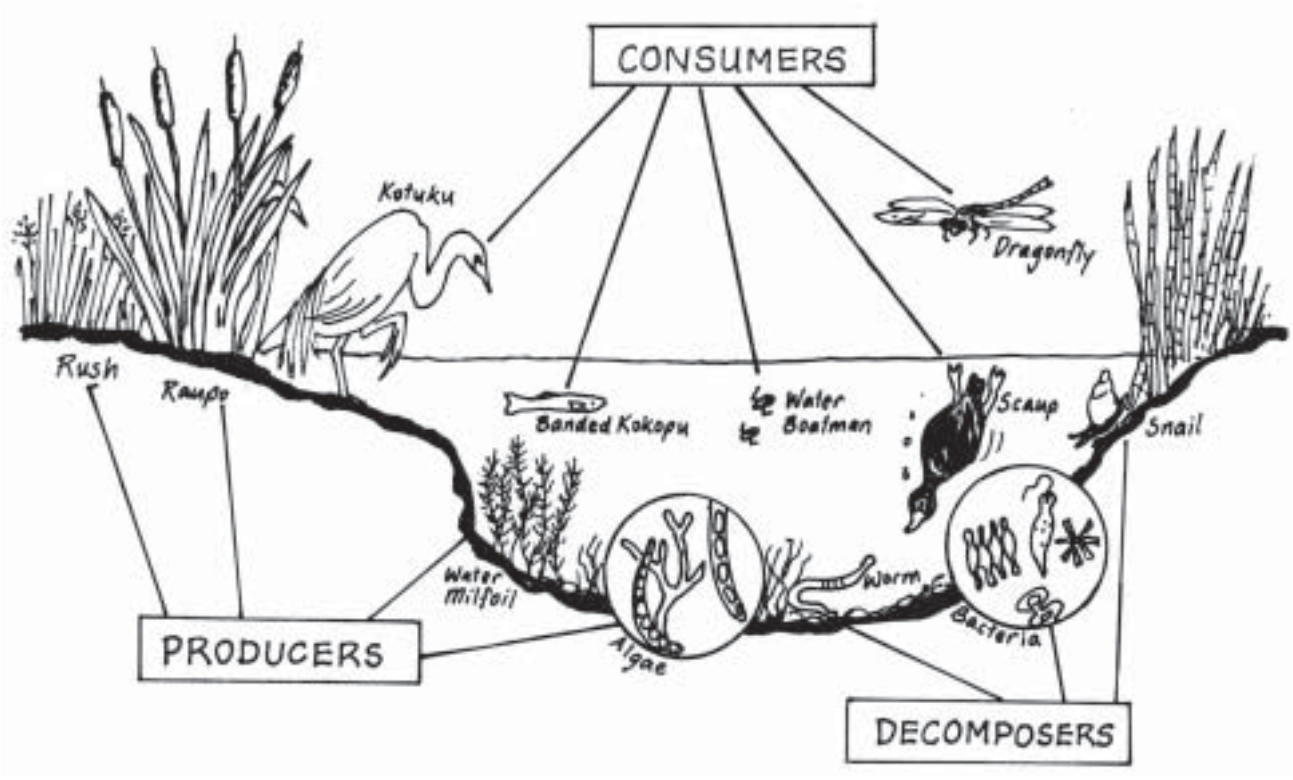
A link with the sun

Plants capture the sun's energy (through a process called photosynthesis) but since animals cannot capture the sun's energy in this way they must obtain their energy by eating plants or by eating other animals. The plant eaters (herbivores) get their energy directly from the plant, while the meat eaters (carnivores) get theirs by eating the plant eaters. Larger meat eaters in turn get their energy by eating from plant eaters or smaller meat eaters. Some animals, such as humans, eat both plants and meat (omnivores).

Producers and consumers

Because of their unique ability to produce energy-laden substances, green plants are called *producers*. All other living things are *consumers*; they consume the energy from plants or other animals. Fungi and bacteria are classed as *decomposers* as they break down and release the nutrients contained in organic matter such as leaves.

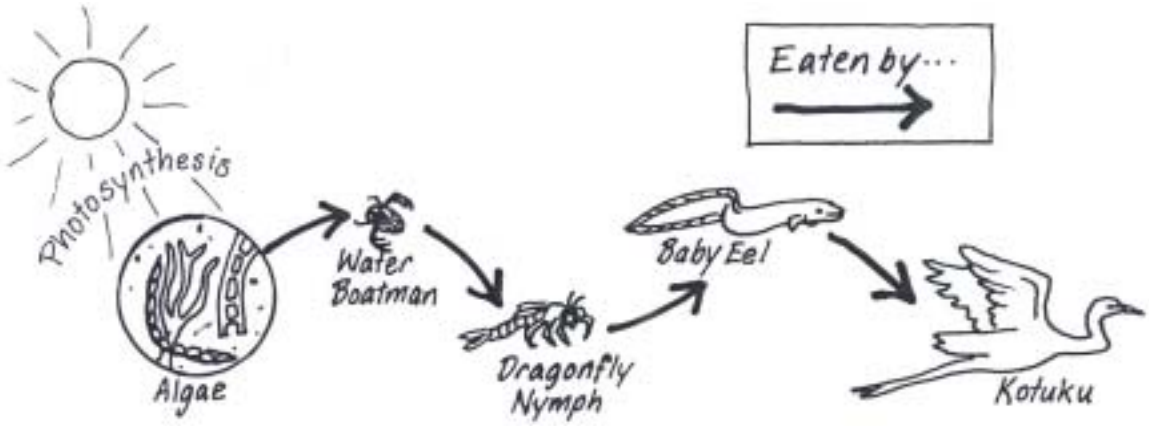
This is an example of the flow of energy in a wetland.



Food Chains

Small invertebrates eat algae. Larger invertebrates, like dragon flies feed on smaller invertebrates and birds then feed on large invertebrates. This is called a food chain.

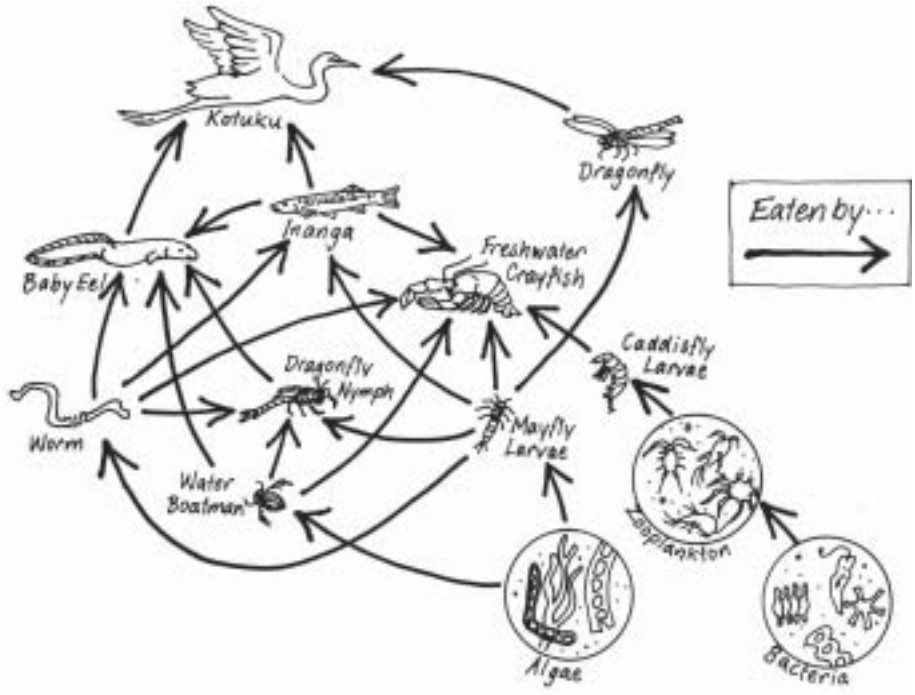
This is an example of a simple wetland food chain:



Food Webs

In every natural habitat you can map out a food chain. However, in reality most feeding relationships are much more complex than the one shown above. These complex relationships are best described as a web, a food web. Food webs include many organisms at each consumption level (trophic level). An organism may eat several different organisms and in turn will probably be eaten by several more. This behaviour is not just about having a varied diet, it is important for survival: if one food source disappears then another will be selected. By drawing links between those living things that eat (or are eaten by) each other, a maze of interconnecting lines appears. Lines are running from every plant (the smallest bacterium to the largest tree) and every animal (the one-celled animals to the largest meat eaters).

This is an example of a wetland food web:



WETLANDS
A 'SUPERMARKET' FOR TAI POUTINI MAORI

Far from being a wasteland, as perceived by many people today, the Tai Poutini wetlands on the West Coast of the South Island were a 'supermarket' for early Maori and the most precious lands they owned.

Early Maori kaika/settlements on the coast were concentrated around the estuaries of the major rivers, from Whakapoai (Heaphy River) and Kawatiri (Buller River) in the north, Mawhera (Grey River), Taramakau, Arahura and Hokitika Rivers in the centre to Okarito, Mahitahi, Okahu (Jacksons Bay) and Whakatipu Waitai (Martins Bay) in South Westland.

There was a very good reason for this pattern of settlement.

The tangata whenua (people of the land) depended on wetlands for their survival. An intricate network of swamps, streams, lakes, rivers, lagoons and estuaries supported a huge diversity of species. These waterways supplied them with almost everything they needed - fish, waterfowl and vegetables as well as building materials and industrial fibres.

If wetlands were the supermarkets, then lowland podocarp forests along their fringes were the delicatessen, the hardware store and the chemist shop, all under one canopy!

Historical records show Ngai Tahu harvested over 200 different species of flora and fauna spread throughout Te Waipounamu (the South Island), its coasts and offshore islands. When Europeans arrived on the West Coast in the mid 1800s, they noted it was the least changed in the Ngai Tahu takiwa / area. On the east coast iwi / people were more reliant on their cultivations and introduced foods, particularly pigs and potatoes.

By contrast, Tai Poutini Maori had to be mobile to harvest such rich resources and in summer widely dispersed along the coast and up the rivers and inland lakes, where they established seasonal fishing and hunting camps. Some kaika specialised in the harvest of particular resources within their rohe / territory and traded these specialties with other settlements as far away as the east coast.

One example was pounamu / greenstone, highly sought after by Ngai Tahu on the east coast and tribes from as far as Te Ika a Maui (North Island). Travellers depended on the food resources of inland wetlands for their survival when following the greenstone trails and trading routes through the mountain passes to Canterbury, Otago and Southland.

The network of waterways within wetlands gave Tai Poutini Maori access by waka / canoe and mokihi / rafts; it was certainly easier to transport heavy loads by boat than carrying it on their backs through the wet, dense Westland forest and swamps.

There were 23 major rivers to cross between Mawhera (Greymouth) and Okahu (Jacksons Bay). People on the move travelled light with few food reserves because they were confident of living off the land, particularly of catching tuna / eels wherever they went.

Flax-bordered streams were the most productive sources of mahika kai / food on the coast. Tuna were nutritious, plentiful during all but the colder winter months and easily caught by a number of methods. Maori used simple techniques like bobbing (threading worms on to flax strings which caught in the teeth of tuna) and spearing to elaborate awa / channels, patuna / eel weirs and hinaki / eel pots to harvest tuna on their annual heke / migrations to and from the sea.

In late summer and autumn, tuna gathered in coastal lagoons and were harvested in large numbers. They were boned, air dried / pawhera on racks then stored for up to 12 months for consumption during winter. Lake Moeraki was renowned for its big tuna and there were summer fishing camps on many of the inland rivers and lakes, including Kotuku-Whakaoho (Lake Brunner Moana) and Lake Paringa.

Mata or inaka / whitebait and the now extinct upokororo / grayling were a special delicacy and major food resource on the coast. Early explorers remembered the days when whitebait shoals were so dense they saw dogs standing on the riverbank lapping them from the stream. The tangata whenua dug awa / channels leading mata into pools where they were scooped out in closely woven harakeke / flax nets. They were laid out and dried on mats for three or four days then stored for the leaner winter months.

River estuaries were rich spawning grounds for sea fish, nesting areas for coastal birds and brimming with numerous species of native trout, including taiwharu and kokopu, smelt and sprats, many of which are virtually unknown today. Patiki / flounders were speared in great numbers in the Mahitahi and Makawhio River estuaries. Seagull eggs were another local delicacy, harvested from their nests on sand spits during November.

In early summer, putakitaki / paradise shelducks, parera / grey duck, pateke / brown teal and tete / grey teal were driven into nets during their moult on coastal lagoons and harvested from waka / canoe. Young ducks were harvested the same way in mid-summer but the adults were released to maintain the breeding population.

Harakeke, raupo / bulrush and ti kouka / cabbage tree grew in abundance on the margins of the wetlands and these were all important sources of food and industrial fibres. All parts of these plants were used. Strong ropes, nets and baskets were woven and plaited from the leaves and fibre of harakeke and ti. The inner stem of young ti kouka was cooked in a hangi/earth oven to extract kauru / sugar, a rich, staple food throughout Te Waipounamu.

Raupo/bulrush was a survival food. Its starchy root stalks were eaten raw or boiled as a green vegetable. Its flowers produce edible pollen that was mixed with water to make gruel or baked into bread when other foods were scarce. The stalks of raupo and wiwi / rushes were used to line and insulate whares / houses. Kuta / reeds were prized for their long hollow stems and were used for rain capes and weaving into whariki / mats.

Another staple, survival food for Ngai Tahu was aruhe/bracken, fern root but this was harder to find on the West Coast other than in the relatively dry Mawhera (Grey Valley) area.

Along the fringes of the wetlands grow the giants of the podocarp forests – among them kahikatea, rimu, miro, matai and totara - valued for their timber, bark, berries, fruits, medicinal properties and the forest birds that lived on them.

When Te Tai Poutini chiefs agreed to sell their ancestral lands to the Crown in 1860, the Poutini Ngai Tahu people retained ownership of many reserves that were largely concentrated in the coastal estuaries, wetlands and river catchments because these areas produced their greatest resources.

Today, the traditions of rangatiratanga / sovereignty and kaitiakitanga / guardianship over the natural environment are crucial to the identity of Ngai Tahu iwi to keep the unique culture, tikanga / customs and mahinga kai practices alive.

Respecting Tikanga (Custom)

School groups should be aware that wetlands were occupied or visited by Maori for many centuries and may have urupa / burial grounds and other wahi tapu / sacred sites that were restricted areas to the tangata whenua/local people. Groups should respect cultural protocols by observing tikanga / customs where possible, for example, not taking food on to such sites.

NOTE: In the southern Kai Tahu dialect, 'ng' is often replaced by 'k' (i.e. tangata = takata). Both forms are used throughout the South Island.

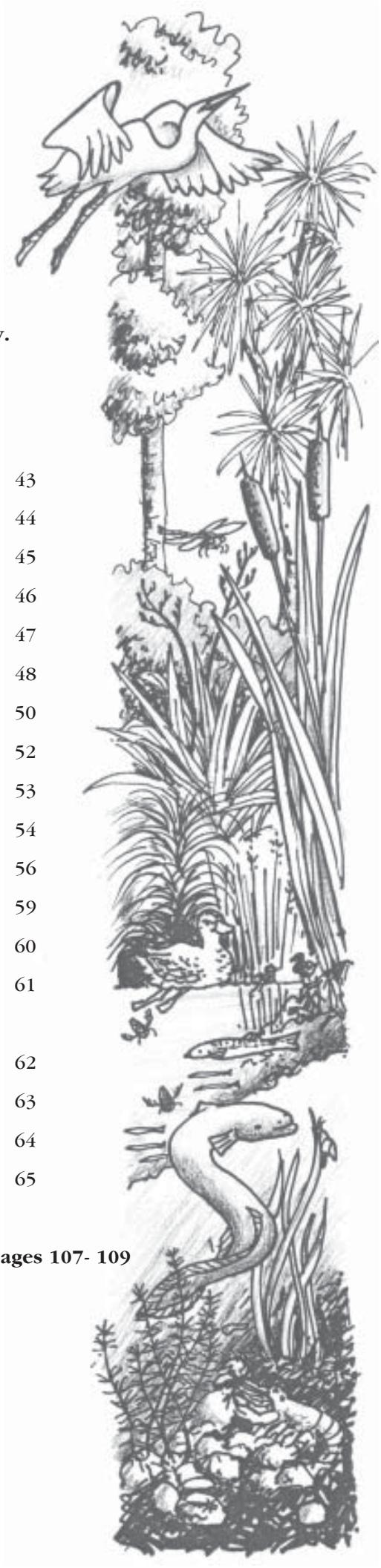
Cultural harvesting of kuta

Lake Mahinapua 2003

Activity Sheets

Select the activity sheets specifically for your study. All of the activities are designed so that they can be adapted to suit your level.

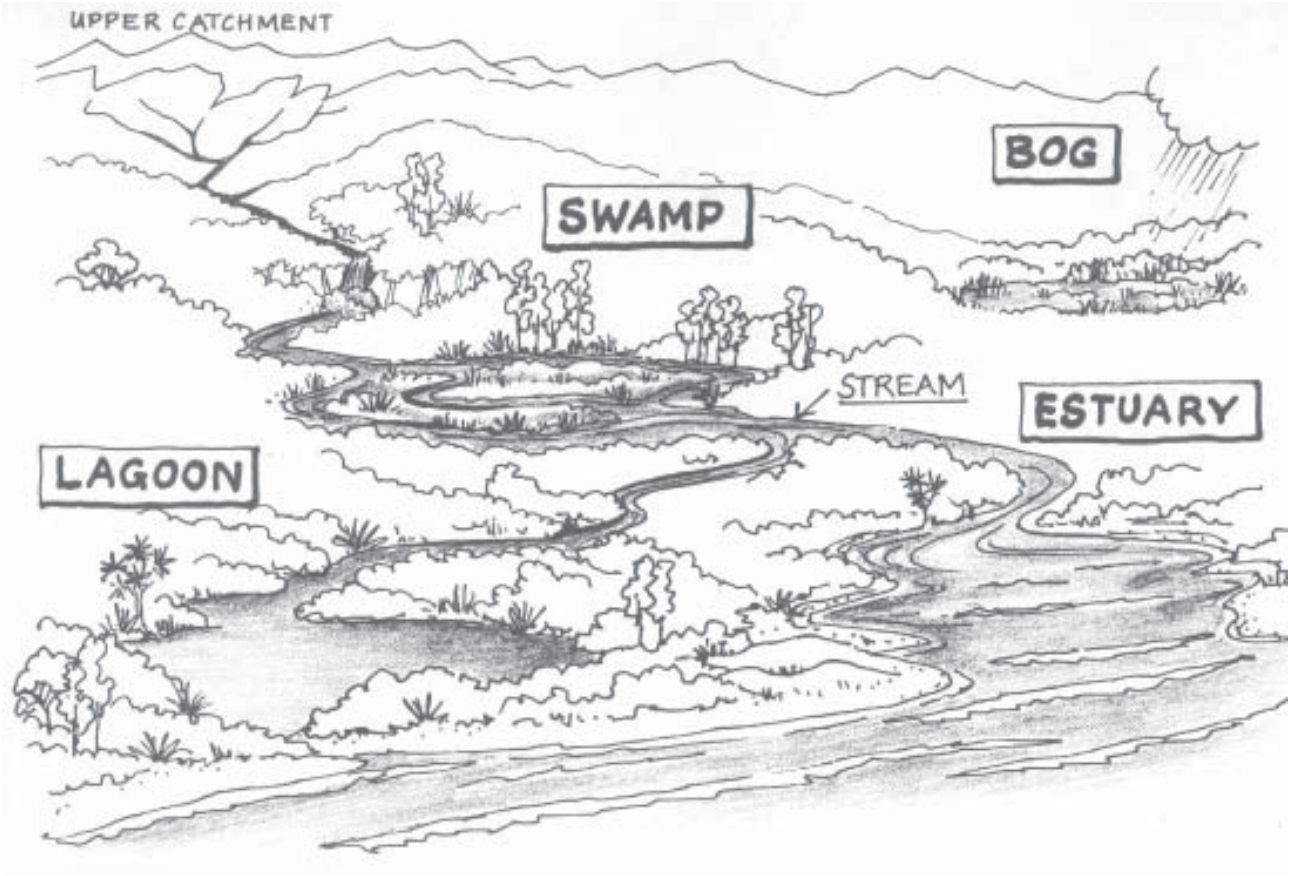
The answers to Activities 1 to 13 are provided on pages 107- 109



ACTIVITY 1: WHAT IS . . . A WETLAND?

Name _____ Date _____

This is a general sketch of wetlands:



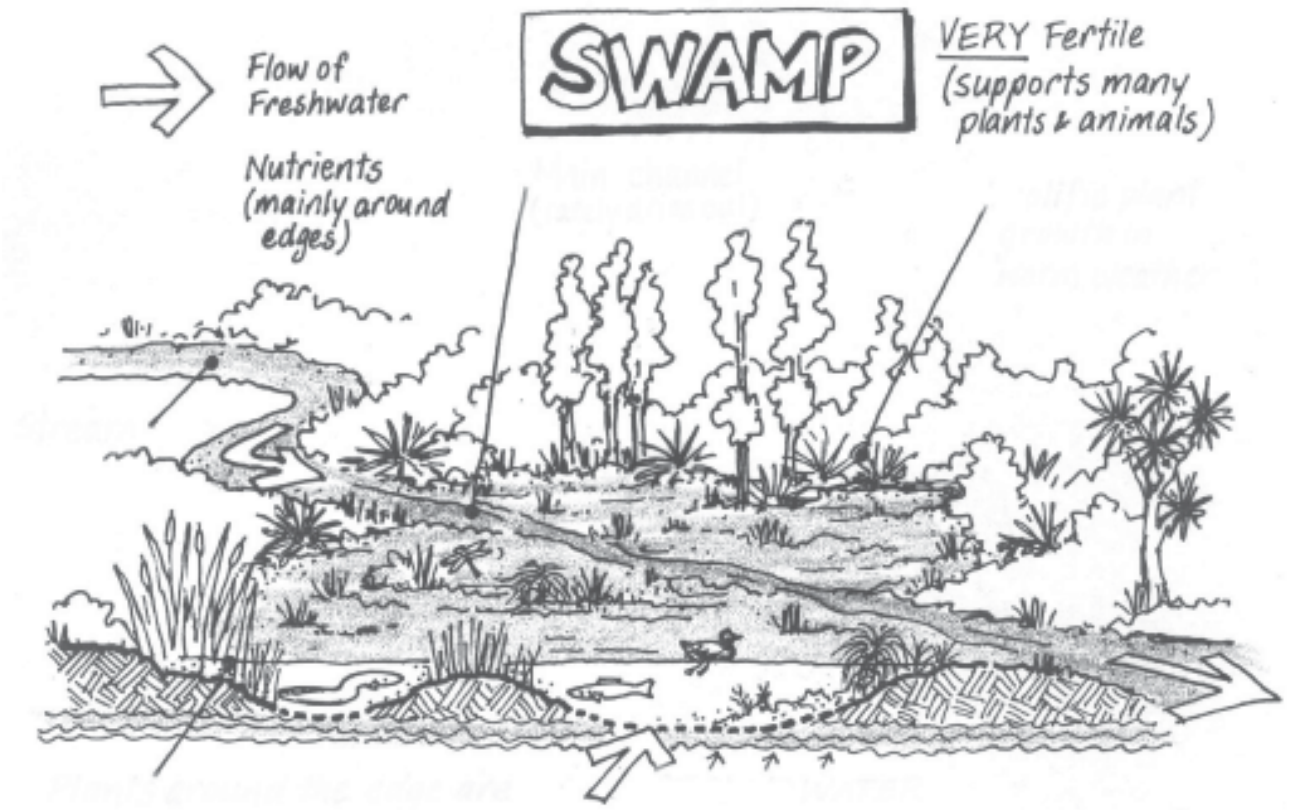
Can you name the features of each of the wetlands illustrated above?

ACTIVITY 2: WHAT IS . . . A SWAMP?

Name _____ Date _____

This is a diagram of a swamp.

Cut out the labels below and stick them into the empty spaces.



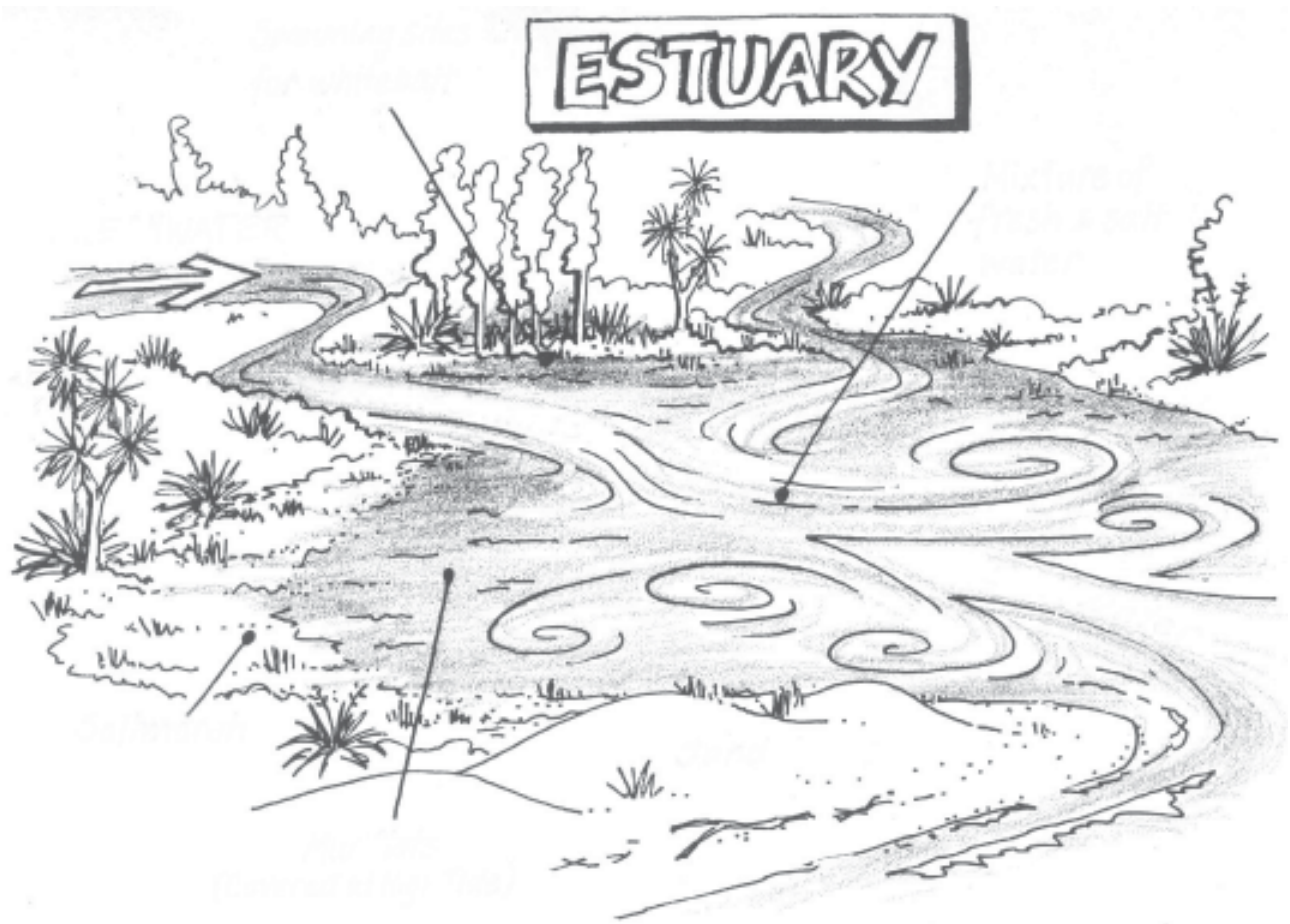
Prolific plant growth in warm weather	Main channel (rarely dries out)	Plants around the edge are good hiding places for wildlife
Stream	Groundwater	

ACTIVITY 3: WHAT IS . . . AN ESTUARY?

Name _____ Date _____

This is a diagram of an estuary.

Cut out the labels below and stick them into the empty spaces.



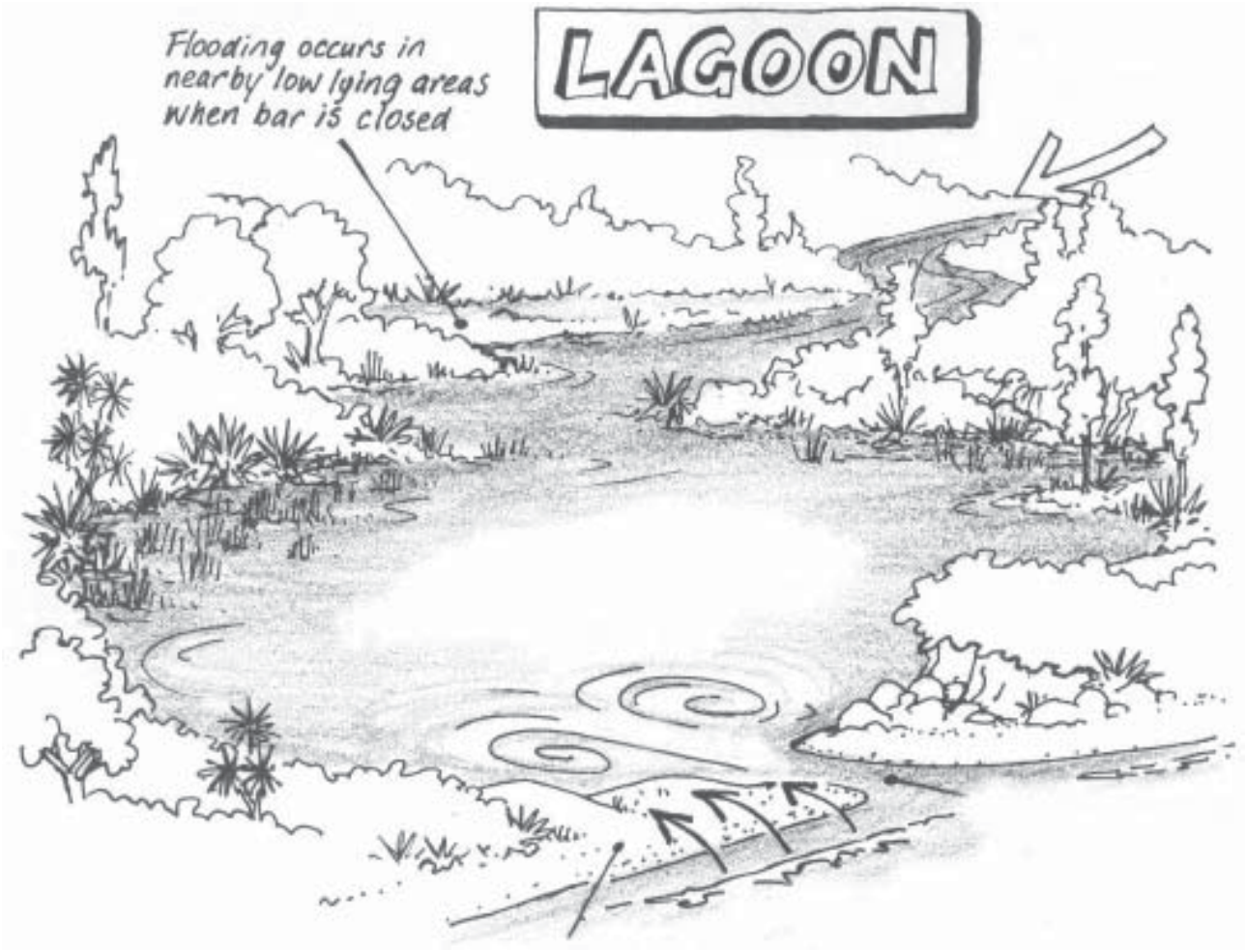
Spawning sites for whitebait	Mixture of fresh and salt water	Mudflats (covered at high tide)
Sand dunes	Freshwater	Saltwater
Main channel	Salt marsh	

ACTIVITY 4: WHAT IS . . . A LAGOON?

Name _____ Date _____

This is a diagram of a lagoon.

Cut out the labels below and stick them into the empty spaces.



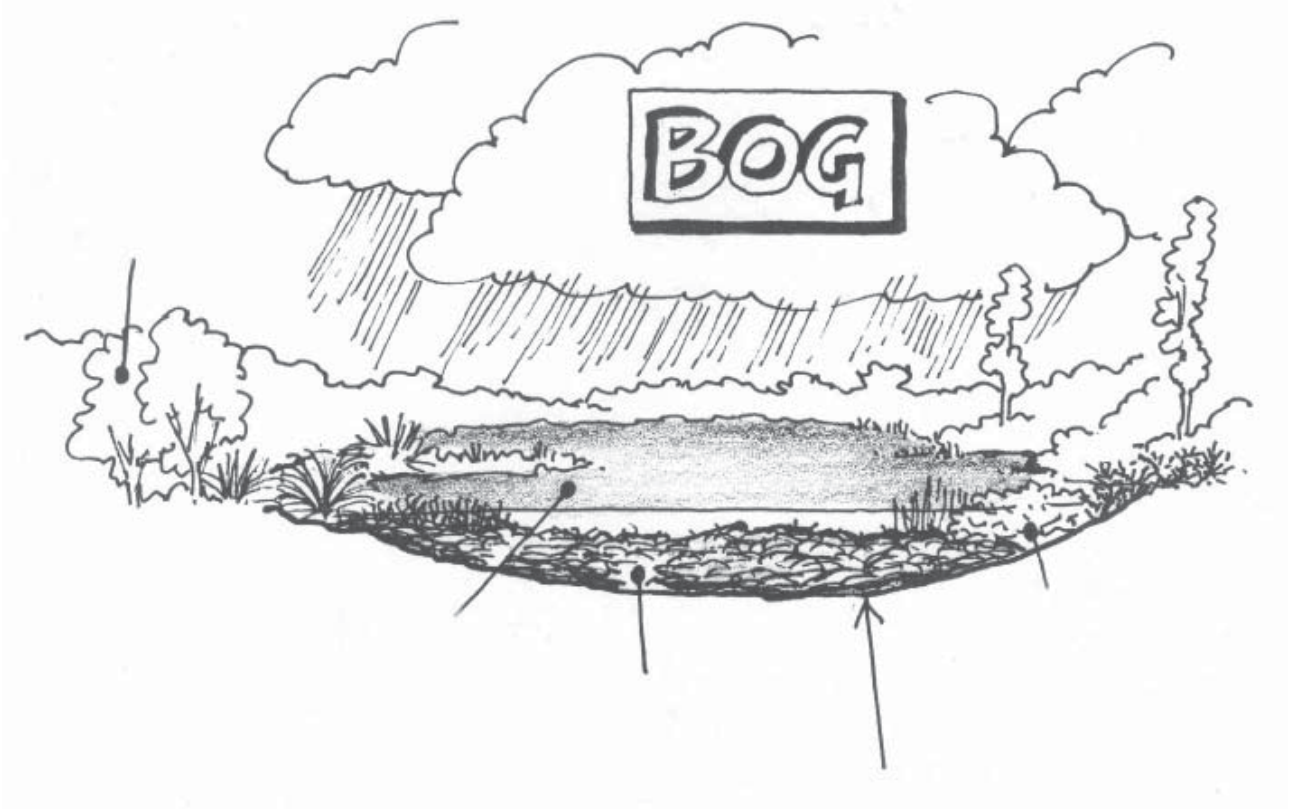
Bar (sometimes closes off)	Waves wash over in storms	Mainly fresh water (but salt water sometimes washes in)
Salt water	Barrier beach	Fresh water flow

ACTIVITY 5: WHAT IS . . . A BOG?

Name _____ Date _____

This is a diagram of a bog.

Cut out the labels below and stick them into the empty spaces.



Spongy peat soil	Acidic water (few nutrients)	Sphagnum moss & other specialised plants
Basin	Manuka on edges	Rain fed only

ACTIVITY 6: HOW WETLANDS CHANGE OVER TIME

Name _____ Date _____

A wetland is in a constant state of change. Natural processes occur that change wetlands into dry-land ecosystems. These changes usually occur very slowly, but may be sped up by human activities.

Tuckers Flat is a wetland close to Kaniere. The photos below show that Tuckers Flat has changed through time.

1. Look at Photo 1. It shows the water wheel and water race used during the gold mining days. What effect did this have on the land?

_____

_____

_____

2. Compare the photos of 1988 with 2001. What is the main difference? Why do you think that is?

_____

_____

_____

3. What other differences can you see between Photo 2 and Photo 3?

_____

_____

_____

4. What do you think Tuckers Flat will look like in fifty years?

Draw a sketch:

Photo 1

Tuckers Flat

1869

Photo 2

Tuckers Flat

1988

Photo 3

Tuckers Flat

2001

5. If you were a wetland animal when would you prefer to live at Tuckers Flat? 1869, 1988, 2001 or the future?_____

Give reasons:

_____

_____

_____

ACTIVITY 7: WETLAND ECOSYSTEMS

Name _____ Date _____

1. Look at the poster *Wonderful Wetlands*.

List all the plants and animals that live in this wetland. Are there any others that you know that are missing?

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

2. Collect information on: what is a habitat?

_____

_____

_____

3. What is *your own* habitat like?

_____

_____

_____

4. Compare your habitat to a class mate's.

SIMILARITIES: _____

_____

DIFFERENCES: _____

_____

5. Consider your town: describe your 'habitat' within the bigger town system.

_____

_____

_____

_____

6. Can you describe the habitat of a bird?

_____

_____

_____

_____

7. A bird lives in a bigger community too. They live next to other birds, above the homes of several insects. This community is called an ***ecosystem***. Can you describe the things that belong in an ecosystem? Remember your 'town' system. What other things, next to inhabitants, does an ecosystem need so that animals want to live in it?

_____

_____

_____

_____

ACTIVITY 8: HABITATS

Name _____ Date _____

Match the correct wetland home to each animal!

Below are eight plants and animals that use wetlands as their home. Can you match them to the areas of the wetland they might live in?

Write the correct number next to the plants and animals.

1. in the trees

2. growing on wet ground

4. on the water

5. in the water

3. hiding amongst plants

Water boatman
hoehoe tuara

Number __

Bittern
matuku

Number __

Swamp fern

Number __

White heron
kotuku

Number __

Grey duck
parera

Number __

Water milfoil

Number __

Flax
harakeke

Number __

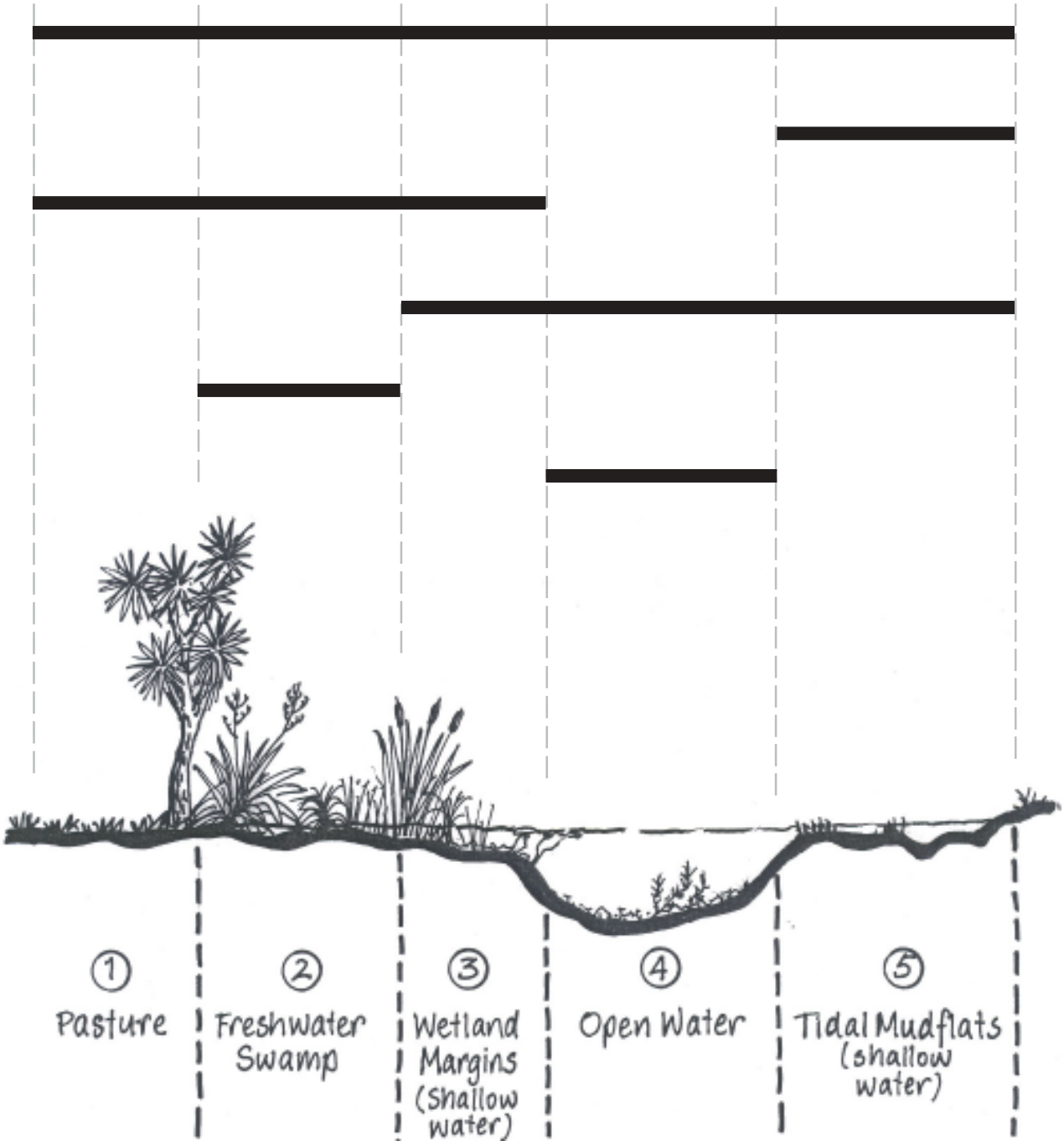
Longfin eel
tuna

Number __

ACTIVITY 9: HABITATS OF WETLAND BIRDS

Name _____ Date _____

Using the *Common West Coast wetland birds* fact sheet on page 36, identify the habitats that these nine birds live in. Write the names of the birds on the habitat lines below. More than one bird may live in each habitat. Use all nine bird names but use each only once.

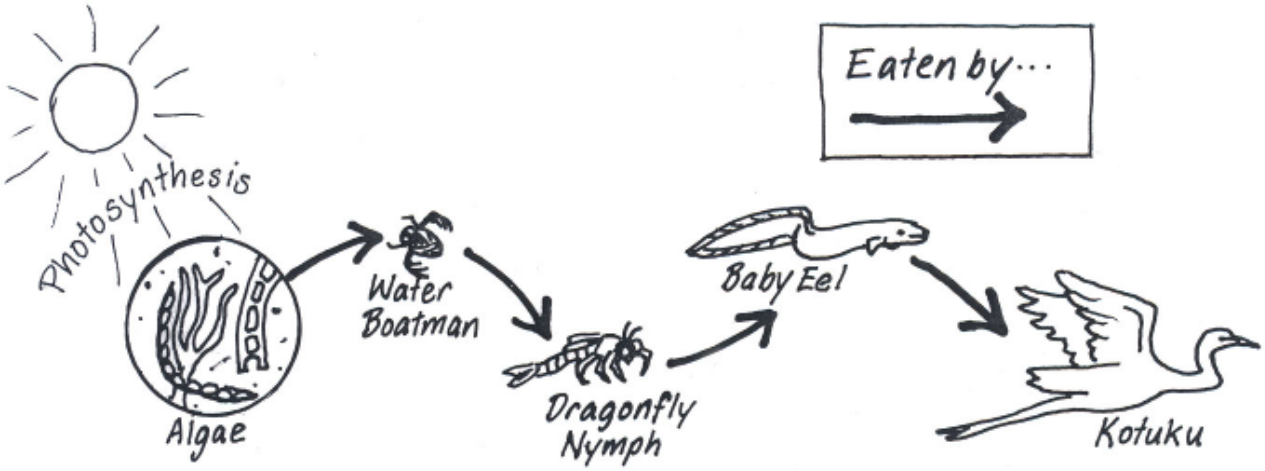


ACTIVITY 10: FOOD CHAINS AND FOOD WEBS

Name _____ Date _____

Who gets eaten and by whom

Below is an example of a wetland food chain which shows how the organisms in a wetland depend on one another:



Algae is eaten by a water boatman, who is eaten by a dragonfly nymph, who is eaten by a baby eel, who is eaten by a white heron / kotuku.

1. Draw a food chain. Put yourself in at level 4:

Level 1	Level 2	Level 3	Level 4

2. What happens if one of the food sources disappears at a certain level?

_____

_____

_____

_____

_____

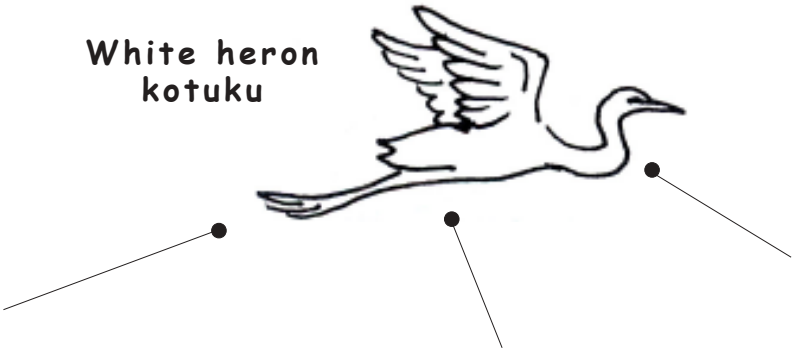
A food chain in the natural world is more complicated because often there is more than one animal eating a plant or another animal.

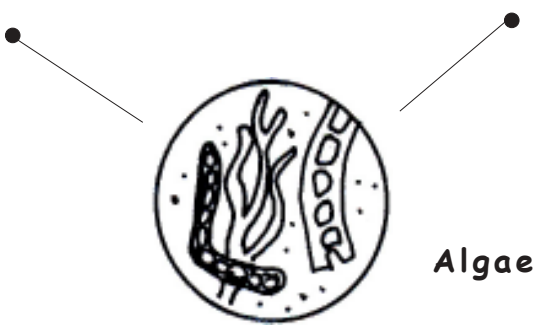
This is called a *food web.*

3. Using these plants and animals draw a food web:

- Algae, dragonfly nymph, baby eel, white heron / kotuku, dragon fly, crawlie, worm, water boatman, bacteria, inanga, zoo plankton, mayfly, caddisfly larvae.

- *Remember that unless an animal is at the top of the food web it will probably eat more than one organism and it will probably be eaten by more than one organism.*



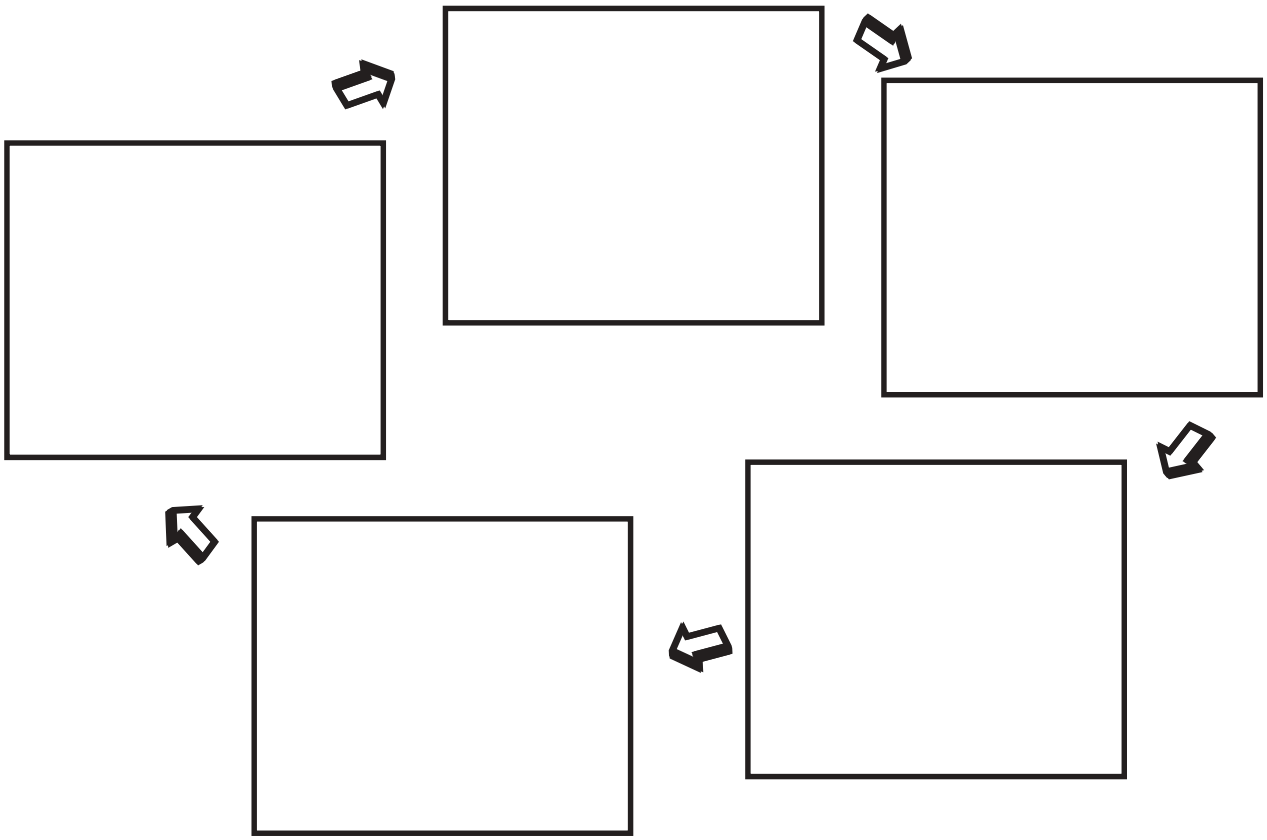


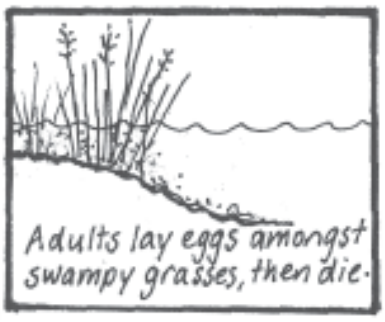
ACTIVITY 11: WHITEBAIT LIFE CYCLE

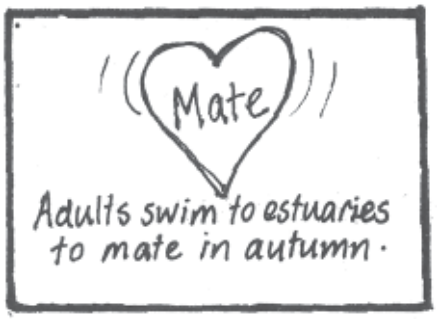
Name _____ Date _____

A life cycle shows the different stages an organism goes through as it gets older.

1. Put the stages of the whitebait into the correct order.







2. The habitat where whitebait lay their eggs is very important. They like calm or still water and lots of cover by grasses at the edge of the water. Can you think of any areas close to you where whitebait could lay their eggs.

_____

_____

_____

_____

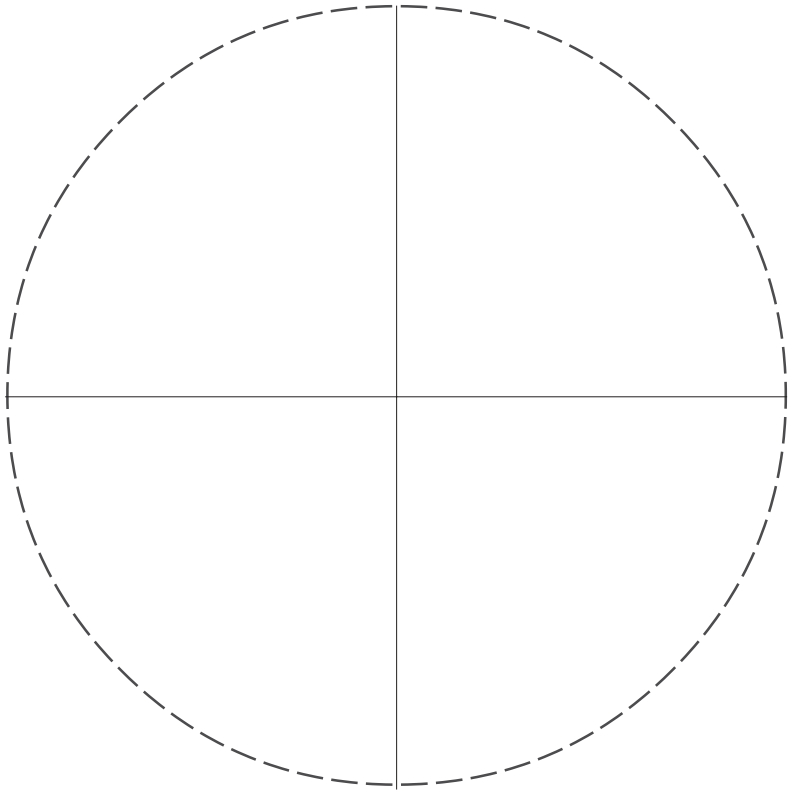
- *Are there any streams nearby where the plants are mowed or dug out along the edge? Talk to the land owner or your local council about letting it grow during late summer and autumn so whitebait have another spawning ground.*

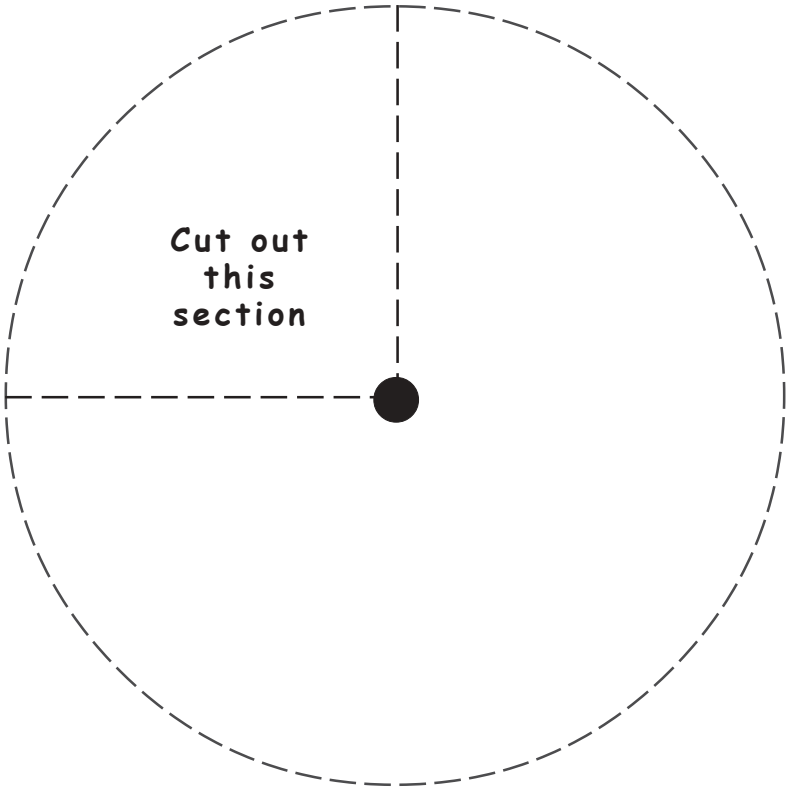
3. Make up a plan of action for you, your group or your class about how to create or look after places that are or could be a whitebait breeding ground.

Who do you need to involve? Where can you find out information? What else do you need to do first?

ACTION PLAN

4. Draw or write out the lifecycle of another wetland plant or animal onto the circle divided into quarters. Cut out both circles along the dotted lines. Place the one with one quarter missing over the complete circle and attach. Now you can see one stage of the life cycle at a time. Tell the story of your animal or plant to a group of classmates.





ACTIVITY 12: I SPY . . . FISH IDENTIFICATION

Name _____ Date _____

Read the descriptions below. Can you match them to a picture?

(Black) Flounder
patiki

Number __

Longfin Eel
tuna

Number __

Catfish

Number __

Common Bully

Number __

Banded Kokopu

Number __

1. I have got a very broad body, almost oval. I have only one fin at the top and bottom which goes right down to my tail fin. Both my eyes are on my right side.

2. My body is shaped like a bullet. Often I grow to 100mm. I like living in gentle flows but am not very fussy. I can also be found in edges of wetlands and small sandy, gravel streams. I am very common in our waterways.

3. I am quite a stocky fish, although my back and my belly are almost parallel. When I was very young and tiny I was considered to be a delicacy but this changes when I am older. I have thin, pale vertical bands along my side and back.

4. I have got a small, smooth head when I am small. When I grow up a muscular dome develops on my head. My body is quite long compared to my other fish friends, actually I can grow up to 2000 mm!

5. Usually, people don't like me in New Zealand. I think it is because I am a predator and eat a lot of snails and crayfish / koura. I consider myself to be quite pretty because of my whisker-like barbels around my mouth. On the West Coast you will find me at Lake Mahinapua only.

ACTIVITY 13: I SPY . . . BIRD IDENTIFICATION

Name _____ Date _____

Look at the pictures of the birds below. They have special bills that help them to feed in wetlands. Can you match the birds to the descriptions? Write the correct number below:

1
New Zealand Shoveler
kuruwhengu

2
Royal Spoonbill
kotuku-ngutupapa

3
Pied Oyster Catcher
torea

4
White Heron
kotuku

- I have a large bill shaped like a spoon that I put in the water and sweep from side to side as I walk along. I eat insects, fish and frogs. Which bird am I?

  Number:_____ My name is: _____

- I have a special shaped bill that I use to sieve the water. I eat small freshwater invertebrates and seeds. I have a bluish grey head. I have a white patch near my flank that helps you to identify me. Which bird am I?

  Number:_____ My name is: _____

- I use my dagger-like bill to catch small fish, aquatic insects, frogs and shrimps, which I swallow whole. I am a tall skinny bird and you can see my pictures on the $2 coin. Which bird am I?

  Number:_____ My name is: _____

- I probe with my long powerful bill in estuaries, mud flats and sandy beaches. I am looking for shellfish, insects and worms. I am black along my back and white on my front. Which bird am I?

  Number:_____ My name is: _____

ACTIVITY 14: HOW WETLANDS WORK

Name _____ Date _____

Equipment needed: 6 small containers, 1 kitchen sieve, 2 kitchen sponges, 1 small bucket on a length of rope, pencil and paper to record results.

1. Use the bucket to get dark water from the wetlands.

Method

2. In two tins combine fresh water with a teaspoon of soil.
3. Pour one tin of the water/soil mixture through the sieve, catching it in one of the empty tins. Set this aside.
4. Place a kitchen sponge in the bottom of the sieve then pour the other water/soil mixture into the sieve.
5. Repeat step four with the same amount of dark water.
6. You now have three tins with the water that passed through the sieve: (a) water/soil mix, no sponge; (b) water/soil mix, with sponge; (c) dark water with sponge.
7. Record results on; the colour of the water, the amount of water and the rate at which it is passed through the sieve.

	WATER / SOIL	WATER / SOIL & SPONGE	DARK WATER & SPONGE
COLOUR			
AMOUNT			
RATE			

Questions

a. Using your results discuss how wetlands work. What do they do to the speed of a river and to the silt in the water?

b. How do plants like sphagnum moss help this process? Think about root systems, stems etc.

c. What effect would a change from a gravel bed to a muddy bottom have on the food web of the wetlands?

d. Explain the difference between *silt-laden* and *dark* water.

ACTIVITY 15: WETLANDS - A 'SUPERMARKET' FOR TAI POUTINI MAORI

Name _____ Date _____

Imagine you landed on this coast 200 years ago and had to survive on the natural resources of the wetlands, forests and beaches around you.

- What would you eat? Make a list of foods you could live on and find out their Maori names (eels - tuna, flounders – patiki etc).
- How would you catch your food? Describe how you would make all the tools and equipment you need to catch, harvest or prepare food.
- What vegetables would you eat? How would you process them?
- How would you cook your food?
- How would you keep it without a refrigerator?
- How would you start a fire?
- What materials could you use to build a shelter?
- Where would you build it? Think about access, sun and shelter from the prevailing winds.
- How would you insulate it? What materials would you use?
- What would you use to make warm clothes?
- What materials could you use to make a raincoat?
- How would you travel up and down the coast to collect all these materials? All this walking would be hard on the feet? What about a pair of shoes or sandals? How would you make them?
- How would you cross deep rivers and lakes? What materials could you use to build a boat, a raft and paddles?
- How long could your family or class live off the land?
- What impact would your harvests of all these precious resources have on this delicate environment?
- How could you minimise the impact you have on the land? Think about how you could ensure your harvests are sustainable in the long term.
- How would you protect this wetland so your children and grandchildren can enjoy the same foods and resources you use today?

ACTIVITY 16: USES OF WETLANDS AND THEIR IMPACT (FOR OLDER STUDENTS)

Name _____ Date _____

In groups:

1. Brainstorm a list of users of wetlands.

2. See if you can place each use into a category such as recreation, economic, conservation etc.

3. What impacts will these uses have?

4. How do these impacts affect the future of the wetland?

NO.	USE		CATEGORY		IMPACT		FUTURE OF WETLAND?
1.	Kayaking	→	Recreation	→	Disturbance of species	→	Decline of species
2.	_____	→	_____	→	_____	→	_____
3.	_____	→	_____	→	_____	→	_____
4.	_____	→	_____	→	_____	→	_____
5.	_____	→	_____	→	_____	→	_____
6.	_____	→	_____	→	_____	→	_____
7.	_____	→	_____	→	_____	→	_____
8.	_____	→	_____	→	_____	→	_____
9.	_____	→	_____	→	_____	→	_____
10.	_____	→	_____	→	_____	→	_____

5. Write down your own thoughts about how wetlands should be used. What could the 'neighbours' of wetlands do differently?

_____

_____

_____

_____

6. What could you do differently?

_____

_____

_____

_____

ACTIVITY 17: SUSTAINABILITY (FOR OLDER STUDENTS)

Name _____ Date _____

What is **sustainability?**

Find out the definition

_____

_____

_____

1. Create a 'mind map'. Different groups could look at local, regional, national and global state of the environment. Think about; what environmental problems are there? Why? What parts of our environment are functioning well? Report back to the class. Use the best points from all the maps and create a poster. Display this poster at a Council, DoC Office, library or where ever you think you could educate other people.

2. To what extent do wetlands contribute to the sustainability of the global environment?

_____

_____

_____

EXTENSION: In the local and/or regional environment, how far is sustainability practised for the wetland/s eg. Harvesting of sphagnum moss or flax.

ACTIVITY 18: CATCHMENTS AND STREAMS (FOR OLDER STUDENTS)

Name _____ Class: _____

Wetland: _____ Date: _____

A catchment is a body of water and there are usually 3 catchments leading to a wetland. These catchments are joined together by a stream.

1. Identify on a map; a wetland, its surrounding area and the location of the catchment/s. Are there any potential threats for the streams and wetland (land uses, deforestation etc.)?
2. List plant and animal species you would find in each of the catchment areas.

   NB. *If accessible, visit a catchment. If not then use the fact sheets on catchments and water quality.*
3. Do you think these threats had or will have an impact on the plants and animals at the catchments?

A stream in a natural condition should be: unpolluted, coming from the mountains, home to a variety of fish and invertebrates, not channelled or dammed, have clear water and have rocks and pebbles in it.

4. How can adding unnatural amounts of nutrients and sediments upset the ecology and stream life eg. run off from farms?

Anything that gets into the stormwater drains will eventually end up in a stream.

5. (i) How do people (including yourself) dispose of everyday items such as paint, detergents, wrappers or cans?

   (ii) Brainstorm ideas for alternative disposal.

   (iii) What changes could you and your family do to prevent this wetland pollution?

Fieldtrip Activities

Fieldtrip Notes

NAME:	LOCATION:	DATE:
WIND DIRECTION:	CLOUD COVER (%):	TEMP. (^{O}C):

OBSERVATIONS AT THE WETLAND

List the plants and animals that you saw.

PLANTS:

_____

_____

_____

_____

ANIMALS:

_____

_____

_____

_____

OTHER OBSERVATIONS:

_____

_____

_____

_____

Draw a bird's eye view of the wetland showing important features like roads, buildings, vegetation, etc. Don't forget to create a key for your sketch.

KEY	

FIELDTRIP

ACTIVITY 1: CHANGES TO WETLANDS AND HUMAN IMPACT

Name _____ Class: _____

Wetland: _____ Date: _____

1. Find a point where you have a good view of the wetland. Draw a sketch of the wetland. Look at the surrounding landforms of the wetland.

2. Can you see any evidence that proves that this place looked different 10, 000 years ago eg. glacial moraine, size of trees, rise or reduction in water level etc?

_____

_____

_____

_____

3. Look at the vegetation: What is happening now to the wetland? Does the water level change? Is this making a difference?

_____

_____

_____

_____

4. Make predictions on what the wetland will look like in the future:

_____

_____

_____

_____

FIELDTRIP

ACTIVITY 2: HUMAN IMPACT ON THE WETLAND

Name _____ Class: _____

Wetland: _____ Date: _____

1. **SOUND LOG:** Listen and record the sounds you hear on the sound log (over page).

- Find a place by yourself in the wetland and sit in silence for 5 minutes.
- Using a compass, point the sound log towards north.
- Record any noise or sound that is heard on the graph paper (you are the centre point) with respect to direction, distance, source, identity etc.
- Name as many of the sounds as possible as you mark them down.
- Finish the sound log by drawing in the different habitats from which each sound came (remember you are the centre point).

2. Divide the sounds you heard into NATURAL and HUMAN. For each human sound state whether it is impacting on the wetland. Give a reason for each.

NATURAL	HUMAN	IMPACT ON WETLAND

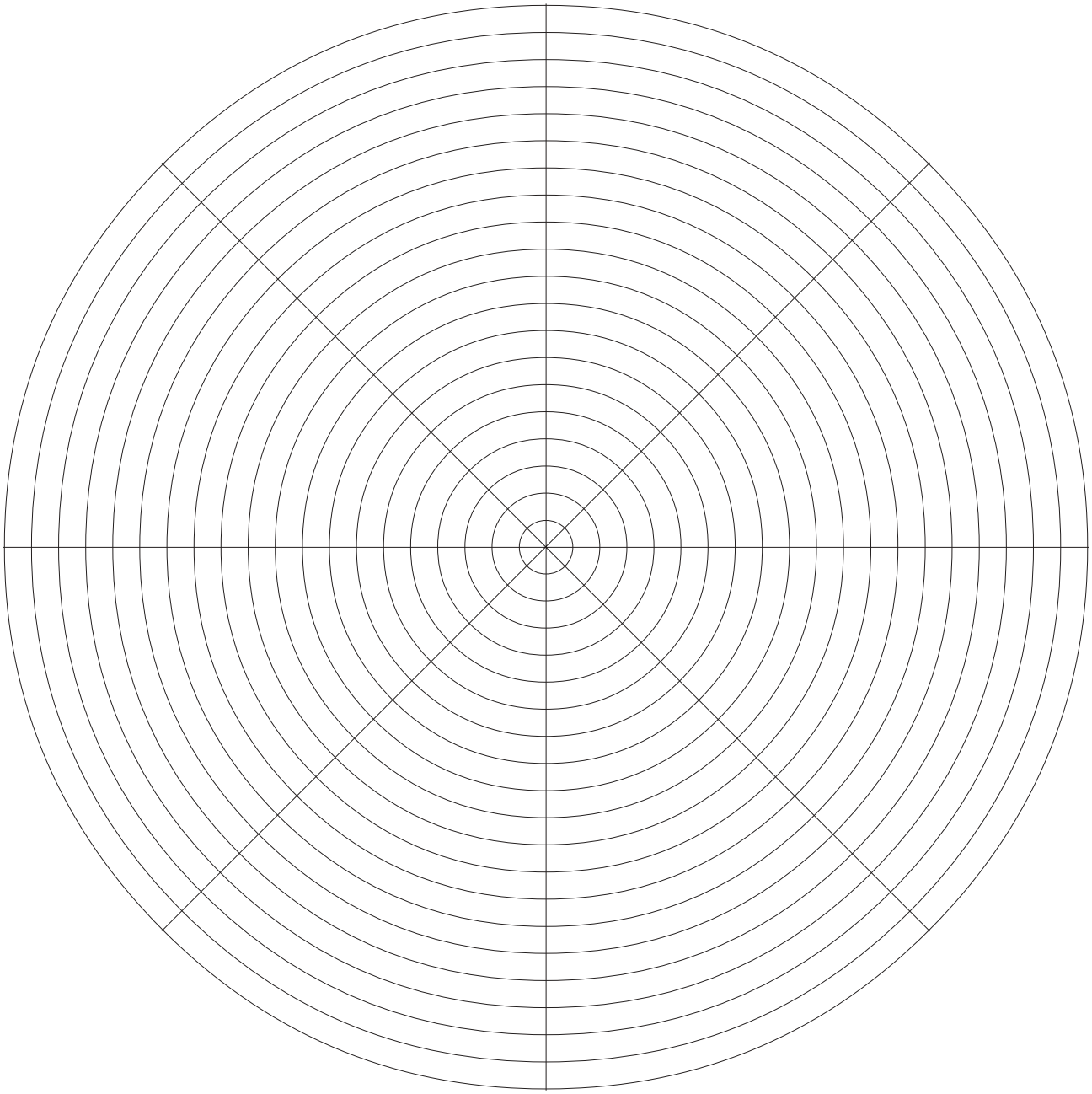
3. Back in the class room answer these questions in regard to your sound log.

- How did these sounds make you feel?
- Which ones did you like / dislike?
- How would you change this soundscape?
- How would these changes impact on the environment?

4. Using the sketch you did in Fieldtrip Activity 1, locate and name on your map any areas that humans have affected (maybe grass mowed close to edge, a building, sounds etc).

SOUND LOG

North



Location: _____ Date: _____

Recorder: _____ Time: _____

FIELDTRIP

ACTIVITY 3: WHO IS LIVING HERE?

Name _____ Class: _____

Wetland: _____ Date: _____

1. On your walk write down what animals you have seen.

_____

_____

_____

_____

2. In the space below draw at least one animal you have found:

On land	In the open water
In the water around plants	On the mud at the bottom

3. Can you see anything special about each of these animals that explains why they live in different habitats?

_____

_____

_____

4. Did you find any animals that lived in two or more different habitats?

_____

_____

_____

5. Create a new creature that could live in all four habitats.

FIELDTRIP

ACTIVITY 4: WATER QUALITY AND INVERTEBRATES

Name _____ Class: _____

Wetland: _____ Date: _____

1. Catch an invertebrate and put into a bug finder, or use a magnifying glass. Sketch it then put it carefully back where you found it and find a different invertebrate.

Sketch	Features	Name (if known)

2. Do you think we can judge how healthy the water is by how many invertebrates you found? Explain your answer.

_____

_____

_____

_____

_____

FIELDTRIP

ACTIVITY 5: WATER QUALITY (FOR OLDER STUDENTS)

Name _____ Class: _____

Wetland: _____ Date: _____

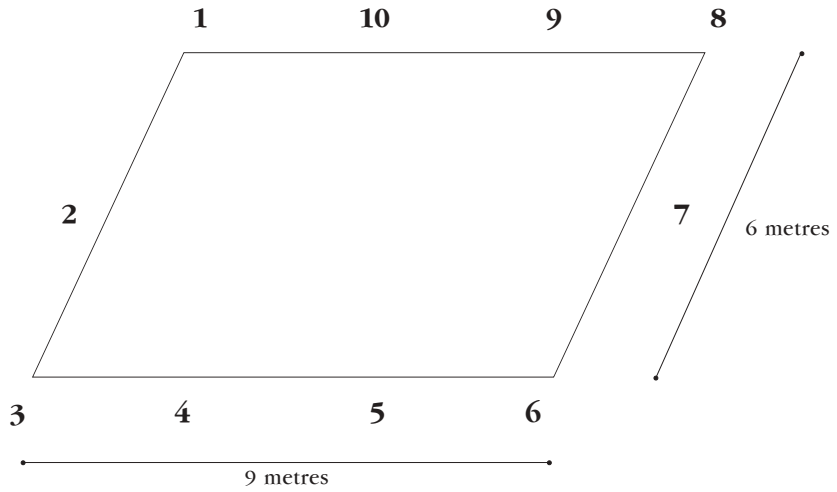
Equipment needed: string, stakes numbered 1-10, sticks (at least 1.5 m long), thermometer, litmus paper, tin can (without label), white tray (1 per group), magnifying glasses

ON THE LAND

Wetland sampling quadrat

1. Mark a quadrat as shown. Place numbered stakes at three metre intervals around your quadrat. Use the numbers to identify locations of sampling.

NB. You may need to make the transect smaller if it's too large for your area.



Test the soil

2. At each location that the stakes are placed, test how hard the soil is by probing with a stick. Observe what happens. Describe with terms such as soft, firm or hard. Decide if the soil is organic, mineral or a mixture. An *organic* soil eg. peat is soft, a *mineral* soil eg. sand, silt is hard.

_____

_____

_____

ON THE WATER

Measure the water temperature

3. Tape a thermometer to a stick approximately 1.5 metres long. Make sure that neither the bulb nor the range from 0 to 25°C is covered by the tape. Lower the thermometer in the water until the stick touches the bottom and keep it there for 30 seconds. Raise thermometer and read temperature immediately. _____ °C

Measure the pH of water.

Ph is used to describe the degree of acidity or alkalinity in a solution. It is measured on a scale from 1 to 14 with 1 being an extremely strong acid content, 7 being neutral and 14 being extremely alkaline. Living organisms are very sensitive to changes in pH.

4. Measure the pH by placing litmus paper into a sample of water from the wetland for 10 seconds. Remove the strip and allow time for the reaction to take place. This will take about a minute. Compare the colour of your strip to the colour of the test kit package.

_____

_____

_____

Soil sampling

5. Attach an old can (without label) to a stick and scoop some soil from the bottom of the wetland. Place the contents on to a white tray. Write down the location from where the sample has been taken. Inspect the texture of the soil sample using terms such as silt, clay, or sand. Check the sample for the presence of invertebrate life using a magnifying glass. Don't forget to put the sample back!

_____

_____

_____

6. How clear does the water look to you?

_____

7. Why should you be concerned about water quality?

_____

_____

_____

8. What are indicators of good quality water e.g. invertebrates?

_____

_____

_____

9. What changes (if any) need to be made around this wetland to improve water quality?

_____

_____

_____

FIELDTRIP

ACTIVITY 6: BIRD COUNTS

Name _____ Class: _____

Wetland: _____ Date: _____

Equipment needed: Bird identification book, paper, pencil, binoculars (not essential)

N.B. This activity can be more specific by researching what bird species are found at the wetland you are visiting before going there with a class. Once there, focus on specific birds in specific habitats, their behaviour – how they move, types of movement etc.

1. Find a place in the wetland where you have a good view of water and land.

2. Look around for different habitats eg. on the water, at the water's edge, in the trees etc.

3. On a piece of paper write in columns for each habitat you can identify.

4. Record each bird you see in each habitat.

5. If a bird moves from one habitat to another make a note of that.

6. Use the bird identification chart to help you name the birds.

7. Note whether the bird is by itself or in a group – estimate the size of the group.

FIELDTRIP

ACTIVITY 7: NATURE AWARENESS SCAVENGER HUNT

Name _____ Class: _____

Wetland: _____ Date: _____

N.B. The list can be adapted to suit the needs of the class and the wetland. You may want to put this activity onto cards.

1. Work in pairs to find and record evidence of the items listed.

Makes notes or draw sketches. **DO NOT COLLECT SAMPLES.**

NATURE AWARENESS SCAVENGER HUNT

Find evidence of the items below and explain the reason why they are there eg. something that protects bird life – fences to keep out people and other predators.

- Something that grows in water.
- Something that lives on another plant.
- Something with long narrow leaves.
- Something with prickles.
- Something people have done in the environment.
- Something that tells people to be careful.
- Something of special interest.
- Something that feels smooth.
- Something that protects bird life.
- Something that has been done to improve the environment.
- Something your own height.
- Something symmetrical.

REMEMBER the Environmental Care Code

- ✓ Stay on the tracks.
- ✓ Treat plants and animals with respect.
- ✓ Enjoy the environment.

NEW ZEALAND ENVIRONMENTAL CARE CODE

Protect plants and animals

Remove rubbish

Bury toilet waste

Keep streams and lakes clean

Take care with fires

Camp carefully

Keep to the track

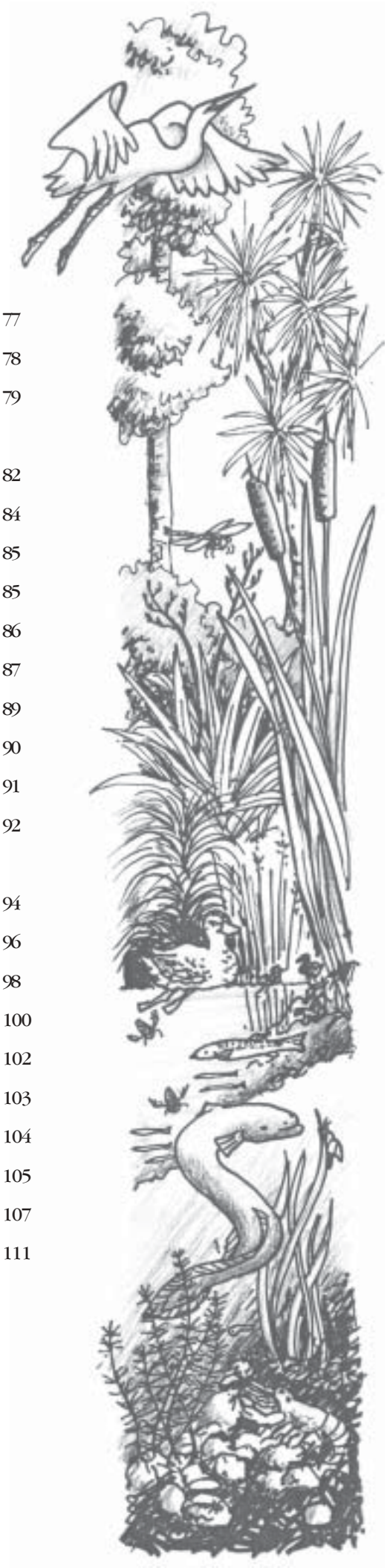
Consider others

Respect our cultural heritage

Enjoy your visit

Toitu te whenua (Leave the land undisturbed)

Extra Resources



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FURTHER INFORMATION

Site	Address
Christchurch City Council	www.ccc.govt.nz/education.asp
Coast to the High Country	www.enved.org.nz
Department of Conservation	www.doc.govt.nz
Ducks Unlimited	www.ducks.org www.ducks.org.nz (NZ branch)
Environment Waikato	www.ew.govt.nz/ourenvironment/water/wetlands/index.htm
Environmental Reporting Programme	www.environment.govt.nz
Fish and Game	www.fishandgame.org.nz
Forest and Bird	www.forest-bird.org.nz
Greenpages	www.greenpages.org.nz
International Peat Society	www.peatsociety.fi/
Ministry for the Environment	www.mfe.govt.nz
National Waterways Project	http://nwp.rsnz.govt.nz
National Wetland Trust of New Zealand	www.wetlandtrust.org.nz
National Wetlands Research Centre (American Site)	www.nwrc.usgs.gov
New Zealand Bird and Birding	www.nzbirds.com
New Zealand Native Freshwater Fish Society	www.nzfreshwater.org
NIWA	www.niwa.co.nz
Oceania Wetlands Helpline	www.wetlandshelp-line.com
Project Wet	www.projectwet.org
Ramsar Convention on Wetlands	www.ramsar.org
U.S Environmental Protection Agency	www.epa.gov.com
Up The Creek	www.upthecreek.org.nz
Weedbusters	www.weedbusters.org.nz
Wetlands International	www.wetlands.org.nz
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GLOSSARY

Alluvium	An alluvial deposit. The term alluvial is applied to the environments, action and products of rivers or streams.
Benthic	Bottom dwelling.
Biota	All species of plants and animals occurring within a certain area.
Brackish water	Mixture of sea and freshwater, characteristic of estuaries and lagoons.
Bog	A wetland deriving its water supply entirely from rainfall, and therefore generally nutrient poor. All bogs have peat and are usually markedly acidic.
Buffer zone	A zone between two areas of different use or characteristics, which diminishes the effect of one area upon the other.
Catchment	The entire area from which drainage water is received by a body of water such as a river or swamp.
Community	A collection of living organisms having mutual relationships among themselves and with their environment.
Decomposer	An organism responsible for breaking down and releasing nutrients contained in organic matter such as leaves and dung.
Ecology	The study of living things in relation to their environment.
Ecosystem	A community of living things and the non-living elements of that community's environment considered as a unit.
Ecotone	Land water margin, transition zone between two habitats.
Endemic	Plants and animals that occur only in New Zealand.
Environment	The sum of all external influences and conditions affecting the life of an organism.
Ephemeral wetland	Wetland that is saturated or submerged for some periods, yet becomes effectively dry habitat at other times.
Erosion	The removal of soil and subsoil by the action of wind and water.
Estuary	Partly enclosed coastal area, which receives both sea and freshwater in a zone of mixing in a tidal regime.
Eutrophic	Well nourished. A condition of lakes and ponds often brought about by human activities, where an over supply of nutrients results in high algae growth and low oxygen levels. This causes aquatic life to deteriorate.
Fauna	The species of animals of a region, or of a period of time.
Flora	The species of plants in a region, or of a period of time.
Food chain	The pathway by which energy and other matter is consumed and flows through ecosystems.
Food web	Concept of interconnecting food chains.
Habitat	Living place of plant or animal.
Herbicide	Chemical substance to kill plants.
Insecticide	Chemical substance to kill insect and similar invertebrates.
Intermittent wetlands	Have irregular fluctuations in water level or water table.
Intertidal	This is the foreshore area between the high and low tides. It includes the overlying waters and vegetation.
Invertebrate	Any animal that does not have a spinal cord at any stage of its life such as worms, insects, spiders, crustaceans and molluscs.

Lacustrine wetlands	Lakes or ponds.
Lagoon	A shallow lake, occasionally connected with the sea. Water fluctuations occur, but are not tidal.
Leaching	The process by which soluble materials eg. iron is removed from the soil by water.
Mesotrophic	Medium fertility, eg. Wetlands and water bodies where some nutrients are supplied in dissolved or sediment form by flowing waters.
Mineral	Materials that are inorganic (see organic). They may be bedrock or sediments of particle size ranging from silt, sand and gravel to stones and boulders.
Minerotrophic	Having a higher nutrient status as water with mineral materials is received or minerals are contained in the substrate.
Mollusc	Molluscs include chitons, clams, mussels, snails, nudibranchs (sea-slugs), tusk shells, octopus and squid. Characteristics of molluscs •Unsegmented soft body •Most have internal or external shell •Have a mantle (fold in the body wall that lines the shell) •Muscular foot and/or tentacles.
Native	Species that occurs naturally in New Zealand, but may also occur in other places.
Natural resources	Natural elements available for human use.
Niche	The role played by a species in an ecosystem.
Nutrients	Elements or compounds essential as raw materials to sustain life.
Oligotrophic	Low fertility, as in wetlands fed by rainwater alone, or water bodies in a stable catchment with high rainfall.
Ombrogenous	A wetland receiving its water entirely from rainfall.
Ombrotrophic	'Rain-fed', having a low nutrient status as water is received only by rainfall.
Organic	Living matter or material derived from it.
Pakihi	Pakihi are a type of wetland seldom occurring outside the West Coast region, and is characterised by poor drainage, and low fertility.
Palustrine	All wetlands not directly associated with estuaries, lakes or rivers.
Peat	Accumulation of partially decomposed remains of plants and animals.
Permanent wetland	Constantly wet, having little fluctuation in water level or table.
Pollution	The presence of unwanted matter or energy (heat, noise, etc.) whose location, nature, or quantity produces undesirable effects.
Primary consumers	Animals that eat plants ie. herbivores.
Primary producers	Photosynthetic organisms ie. plants.
Salinity	The salt content of soils or water.
Seasonal wetland	Water level and water input of a wetland vary with a seasonal event such as spring or snow melt or autumn drought.
Secondary consumers	Animals that eat each other ie. carnivores.
Stagnant water	Water that is still, that has accumulated nutrients and has become oxygen depleted.
Substrate	Underlying material such as gravel or sand.
Subtidal	This is the zone below the level of the lowest tide. It is permanently inundated with water.

Swamp	A wetland where water supply comes from ground water and rainfall. Swamps are usually permanent and are relatively rich in nutrients.
Trophic level	The number of steps in a food chain an organism is away from green plants.
Watershed	The area of land from which the water of a stream or streams originate (see catchment).
Water table	The (water) level relative to the ground surface below which the wetland is fully saturated with water.
Wetland	The Resource Management Act (1991) defines wetlands as "permanently or intermittently wet areas, shallow water or land/water margins that support a natural ecosystem of plants and animals that are adapted to living in wet conditions". They maybe saline, freshwater or brackish.

APPENDIX 1 DOMINANT PLANT SPECIES IN WEST COAST WETLANDS

SCIENTIFIC NAME	COMMON NAME	MAORI NAME	WETLAND TYPE	STATUS
Agrostis stolonifera	Creeping bent		Swamp	Introduced
Astelia grandis			Swamp	Native
Baumea rubiginosa			Swamp	Native
Baumea tenax			Swamp	Native
Blechnum minus			Swamp	Native
Callitriche stagnalis	Starwort		Swamp	Native
Carex secta	Niggerhead	Purei Makura	Swamp	Native
Carex species			Swamp	Native
Carmichaela arborea	Swamp broom		Swamp	Native
Centella uniflora	Centella		Swamp	Native
Coprosma propinqua		Mingimingi	Swamp/bog/ estuary	Native
Coprosma tenuicaulis	Swamp coprosma		Swamp	Native
Cordyline australis	Cabbage tree	Tī kōuka	Swamp	Native
Dacrycarpus dacrydiodes	White pine	Kahikatea	Swamp	Native
Eleocharis acuta	Sharp spike sedge	Kuta	Swamp / lake	Native
Festuca arundinacea	Tall fescue		Swamp /bog	Introduced
Holcus lanatus	Yorkshire fog		Swamp	Introduced
Hydrocotyle novae zelandiae			Swamp	Native
Lotus pedunculatus	Lotus		Swamp	Introduced
Myrsine divaricata	Weeping matipo		Swamp	Native
Phormium tenax	Flax	Harakeke	Swamp	Native
Polygonum salicifolium	Swamp willow weed	Tunawai	Swamp	Native
Viola lyallii			Swamp	Native
Baumea teretifolia	Pakihi rush		Bog	Native
Dracophyllum species			Bog	Native
Drosera species	Sundews		Bog	Native
Empodisma minus	Wire rush		Bog	Native
Epacris pauciflora			Bog	Native
Gahnia species	Cutty grass		Bog	Native
Gleichenia dicarpa	Tangle fern	Waewae kotuku	Bog	Native
Halocarpus bidwillii	Bog pine		Bog	Native

SCIENTIFIC NAME	COMMON NAME	MAORI NAME	WETLAND TYPE	STATUS
Leptospermum scoparium	Tea tree	Manuka	Bog	Native
Lycopodium ramulosum	Club moss		Bog	Native
Sphagnum species			Bog	Native and introduced
Utricularia novae-zelandiae (=monanthos)	Bladderwort		Bog	Native
Apodasmia similis	Jointed wire rush	Oioi	Estuary	Native
Juncus kraussii	Sea rush		Estuary	Native
Plagianthus divaricatus	Saltmarsh ribbonwood		Estuary	Native
Salicornia australis	Glasswort		Estuary	Native
Samolus repens	Sea primrose	Maakoako	Estuary	Native
Schoenoplectus pungens	Three-square		Estuary	Native
Selliera radicans	Selliera	Remuremu	Estuary	Native
Typha orientalis	Raupo		Estuary / swamp	Native
Ulex europaeus	Gorse		Estuary / swamp	Introduced
Myriophyllum species	Milfoil		Lake	Native and introduced
Potamogeton species	Pondweed		Lake	Native and introduced
Schoenoplectus validus	Lake clubrush	Kapungawha	Lake / swamp/ estuary	Native
Juncas species	Rushes		All types	Introduced

APPENDIX 2 BIRDS

COMMON NAME	MAORI NAME	SCIENTIFIC NAME	STATUS
Banded dotterel	Tuturiwhatu	*Charadrius bicinctus*	Endemic
Bittern	Matuku	*Botaurus stellaris poiciloptilus*	Native
Black backed gull	Karoro	*Larus dominicanus*	Native
Black billed gull		*Larus bulleri*	Endemic
Black shag	Kawau	*Phalacrocorax carbo*	Endemic
Black swan		*Cygnus atratus*	Introduced
Blue duck	Whio	*Hymenolaimus malacorhynchos*	Endemic
Blue penguin	Korara	*Eudyptula minor*	Endemic
Canada goose		*Branta canadensis*	Introduced
Caspian tern	Taranui	*Hydroprogne caspia*	Native
Cattle egret		*Bubulcus ibis coromandus*	Migrant
Fiordland crested penguin	Tawaki	*Eudyptes pachyrhynchus*	Endemic
Great (southern) crested grebe	Puteketeke	*Podiceps cristatus australis*	Native
Grey duck	Parera	*Anas superciliosa*	Endemic
Grey teal	Tete	*Anas gibberifrons gracilis*	Native
Little shag	Kawaupaka	*Phalacrocorax melanoleaucos*	Endemic
Mallard		*Anas platyrhynchos*	Introduced
Marsh crake	Koitareke	*Porzana pusilla affinis*	Endemic
New Zealand kingfisher	Kōtare	*Halcyon sancta*	Endemic
New Zealand shoveler	Kuruwhengi / kuruwhengu	*Anas rhynchotis variegata*	Endemic
Paradise shelduck	Putakitaki	*Tadorma variegata*	Endemic
Pied shag	Karuhiruhi	*Phalacrocorax varius*	Endemic
Pied stilt	Poaka	*Himantopus himantopus*	Native
Red billed gull	Tarapunga	*Larus novaehollandiae scopulinus*	Endemic
Royal spoonbill	Kōtuku-ngutupapa	*Platalea regia*	Native
Scaup	Papango	*Aythya novaeseelandiae*	Endemic
S. I.* fernbird	Matata	*Bowdleria punctata*	Endemic
S. I.* pied oystercatcher	Torea	*Haematopus ostralegus finschi*	Endemic
Spotless crake	Puweto	*Porzana tabuensus*	Native
Spotted shag	Parekareka	*Stictocarbo punctatus*	Endemic
Swamp hen	Pūkeko / pākura	*Porphyrio porphyrio melanotus*	Native

COMMON NAME	MAORI NAME	SCIENTIFIC NAME	STATUS
Variable oystercatcher	Torea-pango	*Haematopus unicolor*	Endemic
White fronted tern	Tara	*Sterna striata*	Endemic
White heron	Kōtuku	*Egretta alba*	Native
White-faced heron		*Ardea novaehollandiae*	Native
White fronted tern		*Sterna striata*	Endemic
Woodhen	Weka	*Gallirallus australis*	Endemic
* South Island			

APPENDIX 3 FISH

COMMON NAME	MAORI NAME	SCIENTIFIC NAME	STATUS
Brown trout		*Salmo trutta*	Introduced
Bluegill bully		*Gobiomorphus hubbsi*	Native
Common bully		*Goboimorphus cotidiamus*	Native
Redgill bully		*Goboimorphus huttoni*	Native
Banded kokopu		*Galaxias fasciatus*	Native
Giant kokopu	Taiwharu	*Galaxias argenteus*	Native
Inanga	Inanga	*Galaxias maculatus*	Native
Koaro	Koaro	*Galaxias brevipinnis*	Native
Short-jawed kokopu		*Galaxias postvectis*	Native
Brown mudfish	Hauhau	*Neochanna apoda*	Native
Black flounder	Patiki	*Rhombosolea retiaria*	Native
Long-finned eel	Tuna	*Anguilla dieffenbachii*	Native
Short-finned eel	Tuna	*Anguilla australis*	Native

APPENDIX 4 PEST FISH

COMMON NAME	SCIENTIFIC NAME	STATUS
Catfish	*Ameiurus nebulosus*	In Lake Mahinapua only
Formerly: mosquito fish	*Gambusia*	Not known on the West Coast
Koi carp	*Cyprinus carpio*	
Rudd	*Scardinius erythrophthalmus*	

APPENDIX 5 INVERTEBRATES

COMMON NAME	MAORI NAME	SCIENTIFIC NAME
Backswimmer	Hoe tuara	*Anisops assimils*
Beetles		*Coleoptera (order)*
Caddisflies		*Trichoptera (order)*
Cockle	Tuaki	*Austrovenus stutchburyi*
Common freshwater snail		*Potamopyrgus antipodarum*
Damselflies and dragonflies		*Odnata (order)*
(Blue) damselfly	Kekewai	*Austrolestes colensonis*
(Red) damselfly	Kihitara	*Xanthochemis zelandica*
Dobsonfly larva / toebiter		*Archichauliodes diversus*
Dragonfly	Kapowai	*Uropetala chiltoni*
Freshwater crayfish (crawlies)	Koura	
Freshwater mussel	Kakahi	*Cucumerunio websteri websteri*
Hairy-handed crab	Papaka huruhuru	*Hemigrapsus crenulatus*
Mayflies		*Ephemeroptera (order)*
Mosquito	Waeroa	*Culicidae family*
New Zealand titiko		*Amphibola crenata*
Pea mussel		*Sphaerium novaezelandiae*
Pipi	Pipi	*Paphies australe*
Sandfly larva	Namu	*Aystrosimulium australense*
Stoneflies		*Plecoptera (order)*
Water boatman	Hoehoe tuara	*Sigara arguta*
Water spider		*Argyroneta aquatica*

APPENDIX 6 WEEDS[1]

COMMON NAME	SCIENTIFIC NAME	LOCATION	IMPACT
Arum lily (Death lily)	*Zantedeschia aethiopica*	Swamps, open damp areas, regenerating ex-pasture	Long lived, forms dense patches, poisonous, tolerates extreme conditions once established.
Asiatic knotweed	*Reynoutria japonica*	Shrub land, riparian areas	Forms dense long-lived thickets.
Blackberry	*Rubus fructicous*	Stream and bush edges, swamps	Smothers most low growing species. Impedes access.
Broom	*Cytisus scoparius*	River systems, coastline, wetlands	On impoverished soils it may induce the succession to forest types or a weed community to the detriment of plants like orchids, ferns or herbs.
Buddleia (Summer lilac)	*Buddleja davidii*	River beds, streamsides, disturbed forest and shrublands.	Forms dense stands in a wide range of habitats. In riverbeds it can alter water flow, causing silt build up and flooding.
Canadian pondweed (oxygen weed)	*Elodea canadensis*	Rivers, lakes, dune lakes	Crowds out smaller native species. Grows from stem fragments.
Cape pondweed	*Aponogeton distachyus*	Slow moving streams and ponds.	Can become very dense eg. Mahinapua Creek.
Chilean rhubarb	*Gunnera tinctoria*		Threat not yet fully assessed.
Crack willow	*Salix fragilis*	Streams, lake edges, river margins	Creates dense thickets, rapid growth, tolerates flooding and temperature variations.
Field horsetail	*Equisetum arvense*	River systems, streambanks.	Form pure stands in a wide range of damp habitats, preventing all other plants from growing. Blocks and alters watercourses, causing flooding.
German ivy	*Senecio mikanioides*	Stream edges (esp. in coastal areas), lowland forest and inshore islands	Fast growing, dense smothering habitat.
Gorse	*Ulex europaeus*	River systems, coastline wetlands	Increases nitrogen content on impoverished soils, may induce forest succession to the detriment of herbs, orchids or low ferns. Can have positive effects on ex-forest site, adds nitrogen and acts as a nursery crop.
Grey willow (Pussy willow)	*Salix cinerea*	Stream and lake edges, river systems and wetlands.	Replaces native species in wetlands by forming vast dense stands and thickets. Causes flooding and waterway changes.
Hawkweed	*Hieracium spp.*	Riverbeds, stream banks	Forms dense, long -lived mats, excludes almost all other species.
Heath rush	*Juncus squarrosus*	Acid bogs	Long lived, produces many seeds, tolerates damage and grazing, flooding and dry conditions.
Himalayan honeysuckle	*Leycesteria formosa wall.*	Wet forests, stream sides, damp gullies	Causes succession to vines. Quickly replaces pioneer species.
Kahili ginger	*Hedychium gardnerianum*	Damp forests, stream sides, river systems	Replaces all other species. Deep rhizome beds can become heavy with rainwater, slip and then cause erosion.

[1] Weeds described in this table can be considered pest plants.

COMMON NAME	SCIENTIFIC NAME	LOCATION	IMPACT
*Lagarosiphon (oxygen weed)	*Lagarosiphon major*	Rivers, lakes, dune lakes	Rapid growth, tall, long lived, dense. **This plant has the potential to cause serious damage to West Coast lakes.**
Lotus	*Lotus pedunculatus*	Wetlands, lake and stream sides, riverbeds	Spreads through animals via dung, intentionally planted to stabilise cuttings/roadsides. Smothers low growing species. May induce succession to other introduced species.
Marram grass	*Ammophila arenaria*	Coastal sandy areas	Replaces native sand binding plants, allows succession to weedy shrubs and trees, can change shape of coastline allowing erosion.
Monkey musk (Monkey flower)	*Mimulus guttatus*	Swamps, lakes, streams.	Invades freshwater margins and replaces native species.
Pampas		Cortaderia selloana	Riverbeds, coastline, saltmarsh, estuaries Colonises disturbed sites, replaces groundcovers, creates fire hazard, habitat for possums, rats.
Ragwort	*Senecio jacobaea*	Wetlands, river systems, coastal areas	Forms dense stands.
Spanish heath (Heather)	*Erica lusitanica*	Disturbed shrubland, pakihi wetlands.	Forms dense stands which can prevent growth of other plants.
Spartina	*Spartina alterniflora*	Estuaries and intertidal zones with soft sediment.	Traps sediment destroying intertidal zone and habitat. Can reduce large estuaries and shallow harbours to thin drains surrounded by rough pasture.
Swamp lily (Water poppy similar, bright yellow flowers)	*Ottelia ovalifolia*	Still or low flowing shallow freshwater ponds, lakes	Can cover still or slow-flowing water. Blocks light to native plants below. Stops oxygen supply in lower depths, affecting water flora and fauna.
Tree lupin	*Lupinus arboreus*	Riverbeds, coastal well drained areas, short tussockland	Grows and matures quickly, taller than competing coastal species. Provides cover for introduced species.
Wandering jew (Wandering willy)	*Tradescantia fluminensis*	Damp shaded habitats	Smothers ground. Grows from fragments.

APPENDIX 7 WETLAND SPECIES OF CULTURAL VALUE (TAONGA SPP.)

Birds

Black-fronted tern / tara
Black shag / koau
Black stilt / kaki
Blue reef heron / matuku moana
Blue duck / whio
Brown teal / pateke / tete
Crested grebe / kamana
Fernbird / mata
Godwit / ririwaka / kuaka
Grey duck / parera
Kingfisher / kotare
New Zealand pigeon / kukupa / kererū
New Zealand Shoveler / kuruwhengu / kuruwhengi
Pied stilt / poaka
Pukeko / swamp hen / pakura
Seagulls / karoro / tarapunga
Weka
White heron / kotuku

Fish and freshwater invertebrates

Eels / tuna
Freshwater mussel / kakahi
Freshwater crayfish / koura
Freshwater shrimp / kohitihiti
Giant kokopu / taiwharu
Whitebait / inanga

Plants

Raupo / bulrush
Cabbage tree / tī kouka
Coprosma spp.
Flax / harakeke
Kahikatea
Kowhai
Rushes / wiwi / kuta
Sedge / papao / tākahikahi
Manuka / tea tree
Toetoe

APPENDIX 8 THREATENED SPECIES IN WEST COAST WETLANDS

Vascular plants	**Status**
Myriophyllum robustum	Gradual decline
Deschampsia caespitosa	Gradual decline
Amphibromum fluitans	Gradual decline
Gratiola nana	Gradual decline
Carex tenuilcaumis	Gradual decline
Utricularia protusa	Gradual decline
Crassula ruamahanga	Gradual decline
Orchid species	Gradual decline

Fish	
Anguilla dieffenbachii (Longfin eel)	Gradual decline
Galaxias argenteus (Giant kokopu)	Gradual decline
Galaxias postvectis (Shortjaw kokopu)	Gradual decline
Neochanna apoda (Brown mudfish)	Gradual decline
Geotria australis (Lamprey / kanakana)	Sparse

Birds	
Botaurus poicilotilus (Bittern)	Nationally endangered
Hymenolaimus malacorhynchos (Blue duck)	Nationally endangered
Egretta alba modesta (White heron)	Nationally critical
Podiceps cristatus australis (Crested grebe / kamana)	Nationally critical
Gallirallus australis (Western weka)	Serious decline

APPENDIX 9 POSSIBLE WETLAND SITES FOR A FIELD TRIP

The following wetlands are easily accessible by road, are close to amenities and/or have high values as a wetland. Please contact your nearest DOC office for a more thorough list of wetlands.

- Karamea Estuary
- Birchfield Swamp
- Lake Brunner
- Blaketown Lagoon
- Cobden Lagoon
- Saltwater Lagoon (Paroa)
- Stafford Pakihi
- Lake Mahinapua
- Tuckers Flat, Doughboy Dam
- Lake Kaniere
- Lake Ianthe
- Saltwater Lagoon & Saltwater Ecological Area
- Lake Wahapo
- Okarito Lagoon
- Okarito Pakihi
- Lake Mapourika
- Peters Pool
- Cook River Flats
- Hapuka Estuary

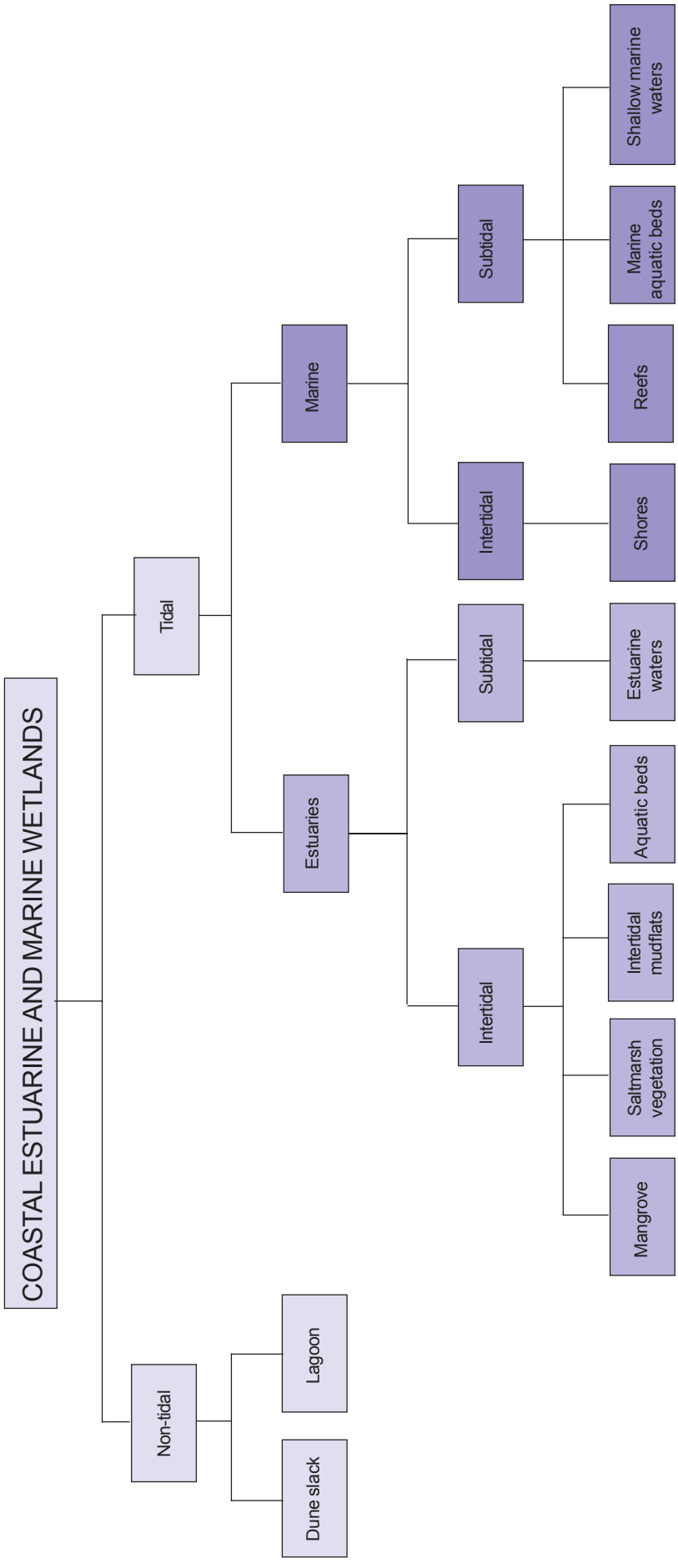


Figure 1 Classification of marine and coastal wetlands

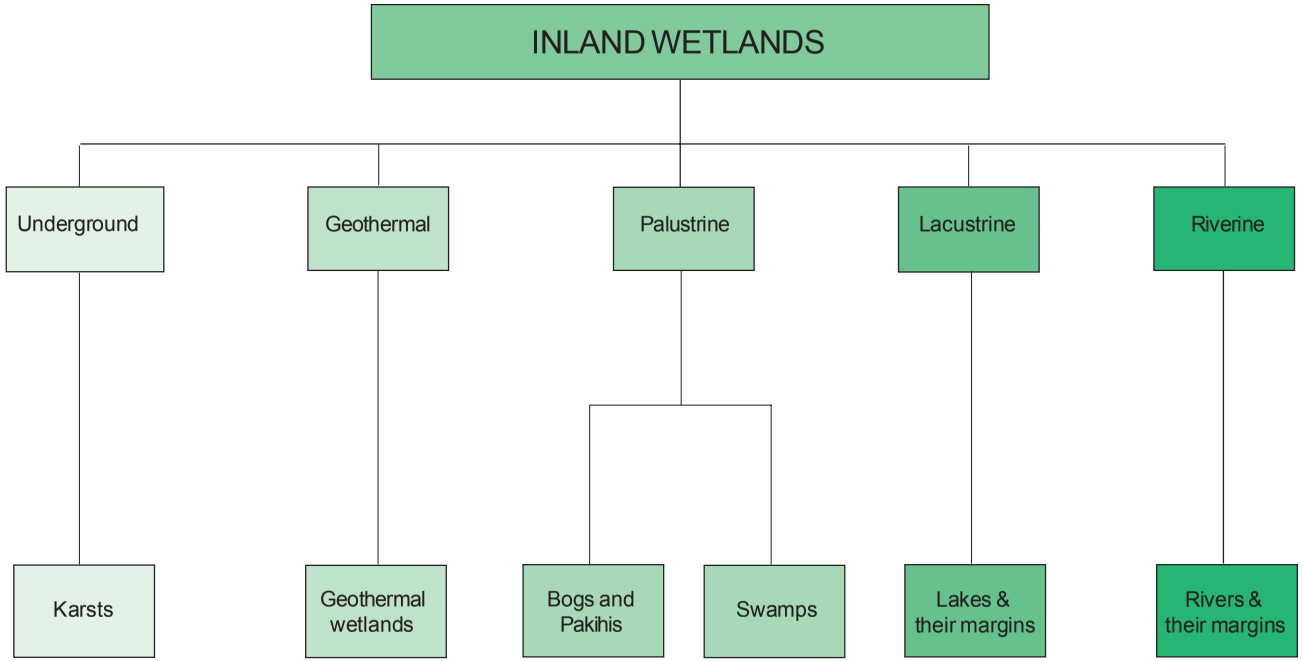
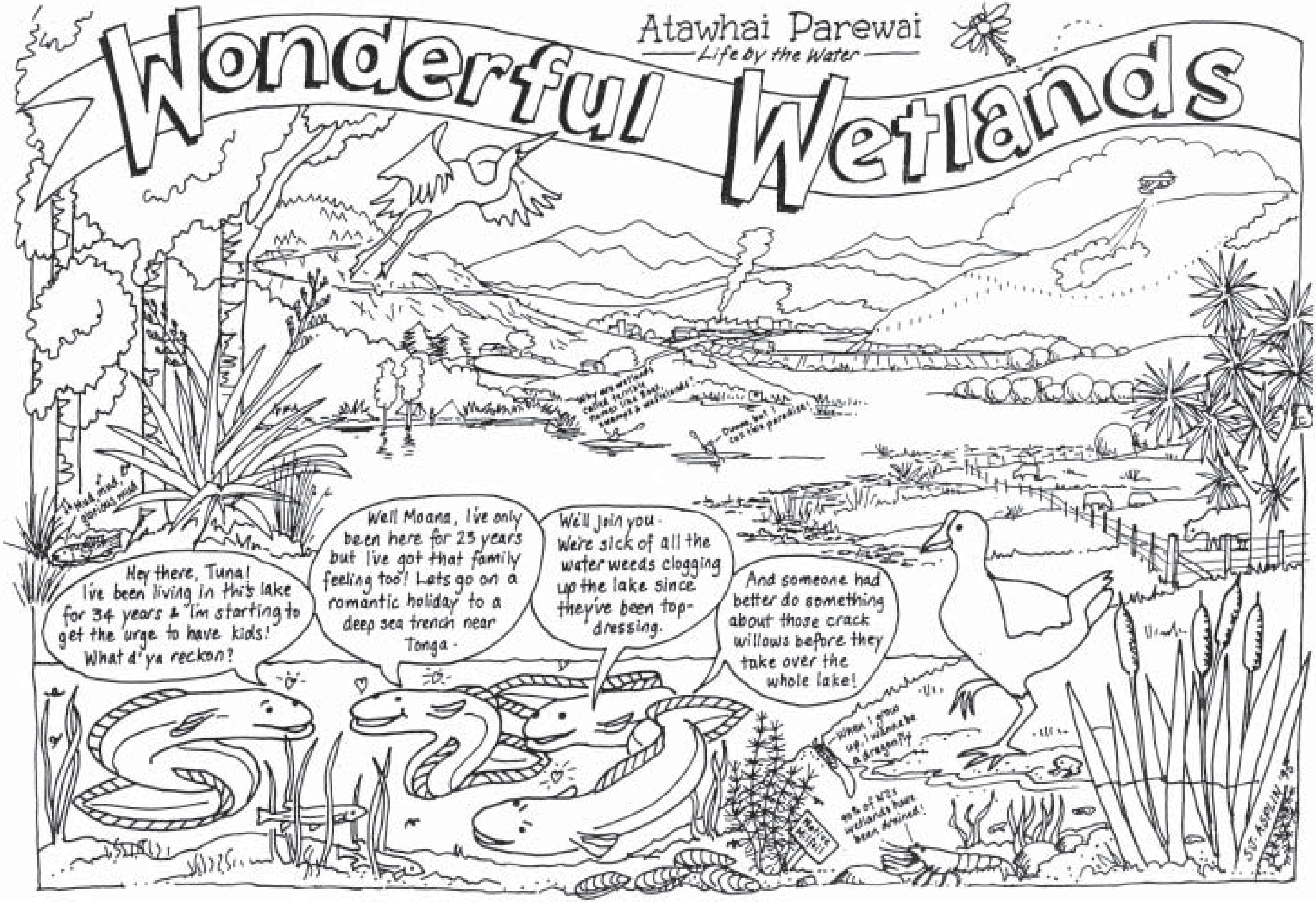


Figure 2 Classification of inland wetlands



Wonderful Wetlands
Atawhai Parewai
Life by the Water
Hey there, Tuna! I've been living in this lake for 34 years & I'm starting to get the urge to have kids! What d'ya reckon?
Well Moana, I've only been here for 23 years but I've got that family feeling too! Lets go on a romantic holiday to a deep sea trench near Tonga.
We'll join you. We're sick of all the water weeds clogging up the lake since they've been top-dressing.
And someone had better do something about those crack willows before they take over the whole lake!
Dunno but I call this paradise!
When I grow up, I wanna be a dragonfly
90% of NZ's wetlands have been drained!
SJ ASPLIN '95

Wonderful Wetlands

The Lake Life – find us in the cartoon!

Pukeko have wonderful blue and green feathers, and flash their white tails when they are frightened. They don't like to fly unless they have to, but can fly very well – they came to New Zealand thousands of years ago by flying all the way from Australia!

Kotuku, the white heron, returns every year to its nesting site in a forest swamp near Whataroa in Westland. Its pointed bill is perfect for spearing small fish.

Raupo (bulrush) swamps are great hiding places for birds.

Kahikatea is New Zealand's tallest native tree, growing to 60 metres high. Some are over 600 years old.

Dragonflies are the helicopters of the insect world, able to hover and turn with ease. Young dragonflies live for up to 3 years in their lakeside burrows.

Koura (freshwater crayfish) have gills that let them breathe underwater. They are distant cousins of the rock lobsters that live in the sea.

Giant Kokopu are one of New Zealand's largest stream fish, growing up to 40cm long. They hide among flax and rushes in streams and swamps not far from the sea.

What's wrecking the Wetlands?

Most of New Zealand's wetlands have been drained for farmland, towns and roads. Only one tenth of our national wetlands are left.

More than 200 wetland plants have been brought into New Zealand from other countries. Weeds like crack willow, grey willow and pond weed are taking over the edges on some of our most important lakes and swamps.

The Fish Out of Water

Few people know that one kind of fish in New Zealand can live out of water for weeks and weeks.

The mudfish, known to Maori as waikaka or hau hau, is specially adapted to living in wetlands that dry up during the hot, dry summer days. They can live in damp ground in forests or in clogged farm ditches, well away from any stream or river. When water levels fall, mudfish hollow out a small hide in a clay bank. There they lie quietly until the next storm brings water flowing into the drain or pool once more.

Early settlers sometimes even dug mudfish out of their damp potato gardens. Maybe these were New Zealand's first fish and chips!!

Mudfish are found in the Auckland, Wellington, Canterbury and Westland regions of New Zealand. They are not as common as they once were because most of the swamps where they like to live have been totally drained to make dry areas for farms and towns.

What Can I Do?

Indoor Activities

Write a story or poem about a mudfish.

Make up a 'Wetland Conservation Code' that lists ways to look after swamps and lakes.

Activities by the Wetland

Survey people at a lake to find out why they came and what they do there.

Go boating with an adult. Don't forget your lifejackets!

Collect seeds or cuttings from lakeside plants (try cabbage trees or flax) and try to grow them back at home. Plant some of them back out by the lake once they're big enough. (Seek landowner/managers permission before collecting plant material)

Clean your boat every trip so you don't carry weeds to other lakes.


Atawhai Parewai
Life by the Water
SPECIAL STREAMS
We sandflies breed on the edges of streams
People don't like us but we bite 'em
Us girls need blood to help our eggs grow
We drink nectar from Kowhai flowers
Kowhai usually grow close to streams because the water spreads their seeds.
We need to look after our rivers & streams, and the plants & animals that live there. YOU CAN HELP by planting trees to protect the river banks from erosion.
Ooor yuk! What's that stinky gunk pouring out of that pipe - I feel sick!
Hey, this bush was just being planted when I swam up this river as a young elver.
Maybe all these planted riverbanks will help make the stream less silty.
Yeah, so long as fences are built to stop the cows trampling & eating the young seedlings.
S.A.SPLIN '95

Special Streams

The Stream Team – find us in the cartoon!

Grey ducks (parera) are native to New Zealand. They love to hide among riverbank scrub, and dabble for food in shallow streams.

The bell-like song of the tui includes notes that are so high (like a dog whistle) that we can't hear them!

Kowhai and other trees help to shade streams from the hot sun, and are homes to many birds and insects.

Harakeke (flax) grows by the water. It's a great home for insects, spiders, birds and fish. And it's good for weaving all sorts of things.

Sandflies (namu) love to suck your blood, but are themselves eaten by fish and birds of the streams.

Ti kouka (cabbage tree) has been in New Zealand for 15 million years! Maori discovered that the young leaf buds and shoots are very tasty.

The young larvae of some insects such as mayflies and stoneflies live in streams. They shelter under stones or lie flat against the rocks, so they aren't swept away by the water. Fish love to chase and eat them, which is why anglers tie feathers that look like insect larvae onto their fish hooks.

What's Spoiling the Streams?

Farm animals love to drink stream water, but sometimes they can trample stream banks, eat native plants and pollute the water.

Trees by streams are the homes for a lot of plants and animals, but they have been cleared from the banks of many streams. The roots of streamside plants help to hold the soil together and stop it getting washed away.

Sewage and other pollution is pumped into some waterways.

Streams are often built up with stop banks or rocks to stop them flooding the land, but this can destroy the natural edges of the streams.

Rainwater flowing from hills and towns can carry pollution down to the streams and rivers. A lot of town drains flow straight into nearby streams.

River dams that are used to store water can stop fish from moving up and down streams as most of them need to do.

Some Words to Know

Add labels to the cartoon pictures to show:

Wai – water	Ngahere – tree
Puke – hill	Maunga – mountain
Roto – lake	Awa – river
Moana – sea	Rangi – sky
One – beach	Takutai – coast
Wahapu – estuary	

What other words describe Life by the Water?

What Can I Do?

Indoor Activities

Build a fish out of paper, cardboard, sticks, wool . . . whatever you can find!

Make something from harakeke: a bracelet, a kete (kit) or a bird feeder to hang outside.

Find out where the water that runs out of your bath, sink, toilet and roof guttering ends up. Your parents or the local council office might be able to tell you.

Look on a map of New Zealand to find the names of some rivers that start with "Wai".

Activities by the Stream

Look for the young larvae of insects, under stones in the stream.

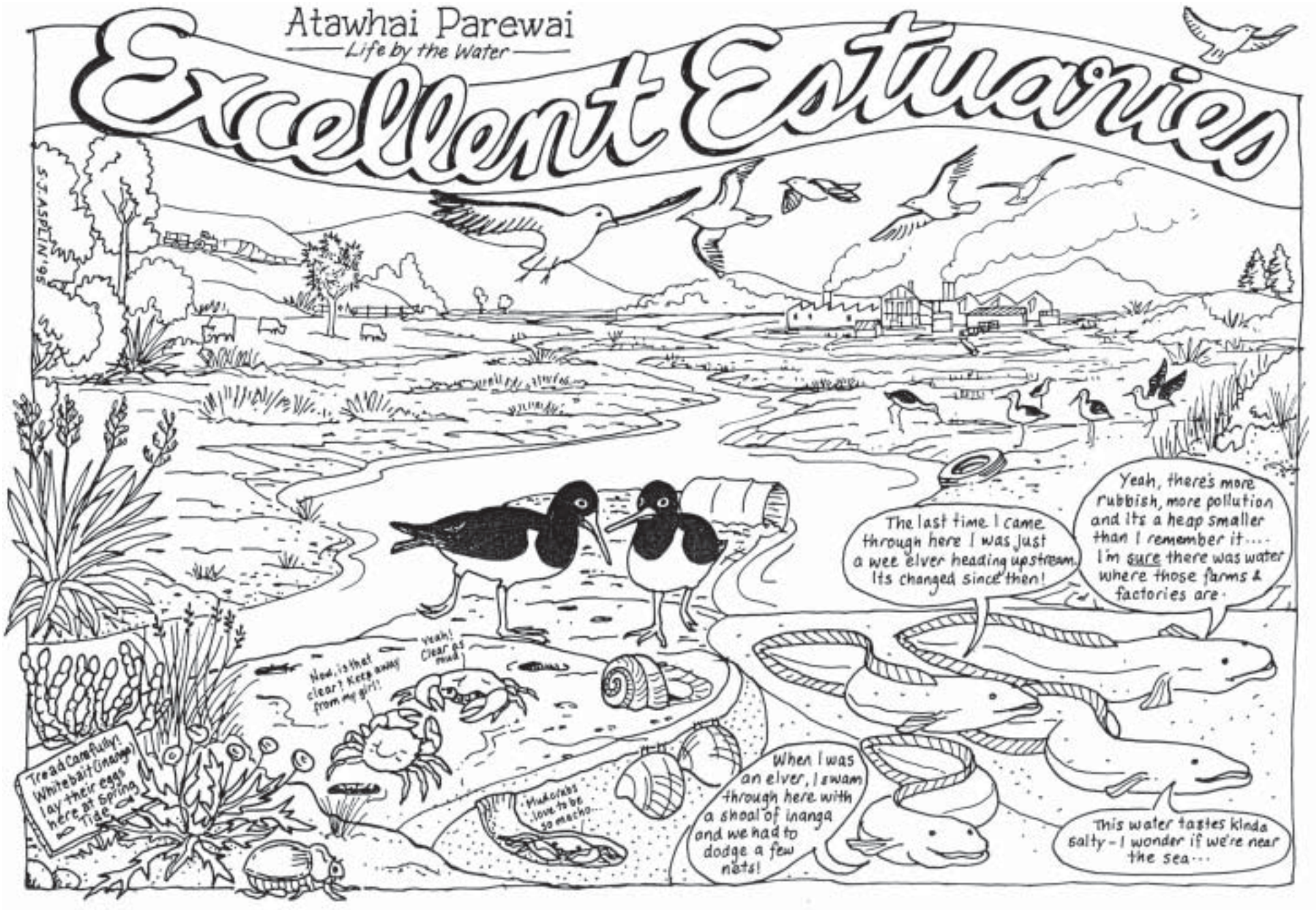
Talk about why trees are good for streams.

Taste the nectar from a harakeke flower. Mmm, no wonder the tui likes it!

Listen for different sounds – how many can you hear?

What would the stream be like in a flood? Where do fish, birds and insects go in a flood?

Plant a tree! Or better still, organise a working bee to plant up the whole riverbank, in a place where they'll be safe from cows and other animals.


Atawhai Parewai
Life by the Water
Excellent Estuaries
S.J. ASPLIN '95
The last time I came through here I was just a wee elver heading upstream. Its changed since then!
Yeah, there's more rubbish, more pollution and its a heap smaller than I remember it.... I'm sure there was water where those farms & factories are.
When I was an elver, I swam through here with a shoal of inanga and we had to dodge a few nets!
This water tastes kinda salty - I wonder if we're near the sea...
Tread Carefully! Whitebait (inanga) lay their eggs here at Spring Tide
Woa, is that clear? Keep away from my girl!
Yeah! Clear as mud!
Mudcrabs love to be so macho...

Excellent Estuaries

The Mudflat Mob – find us in the cartoon!

Cockles are shellfish that grow in their millions, out of sight in the estuary's mudflats.

Torea, the oyster catcher, eats up to 350 cockles a day!

Red billed gulls love to steal the opened cockles left by torea.

The tunnelling mud crab makes a hole near the edge of the estuary where it lives all its life, coming out at each low tide to find scraps of food.

Pied stilts (poaka) make their nests near coasts, estuaries, rivers and lakes, but their favourite foods are the crabs and shrimps of the estuaries.

Glasswort lives in New Zealand's northern estuaries, and tastes salty (but sheep love to eat it too!)

Bachelor's buttons is a plant named for its round yellow flowers that colour the estuary margins in the spring.

Sand scarab beetles often fly into coastal towns on warm summer nights. When they were young grubs, they burrowed into the sand to eat the roots of estuary plants.

Whitebait are the young fish of the inanga and a few other native fish. Inanga lay their eggs in the bankside grasses at very high tides in the autumn.

Mud snails eat twice their own weight in mud every hour! The mud has lots of yummy food in it.

Godwit, the Round-the-World Wader

Kuaka, the godwit, is one of the most common birds of New Zealand's estuaries. It is one of the many kinds of birds called "waders", because its long legs let it wade in the shallow water of the estuary looking for food.

But instead of staying in the estuaries all their lives, godwits fly half way around the world and back again every year!

During the summer, kuaka spends its time catching worms and crabs on New Zealand's estuary mudflats, pulling them out of the mud with its long, curved beak.

In the winter, thousands of kuaka make the long, long journey to Siberia (in Russia), where they lay their eggs and raise their young. At that time it's summer in Siberia, and there's plenty of food for them there. But after a few months, they fly all the way back to New Zealand again.

What's Eating the Estuaries?

Some people think that estuaries smell bad and are no use to anyone. But other people think estuaries have the great smell of the sea, and know that they are important feeding grounds for fish, birds and shellfish.

Many of New Zealand's estuary edges have been filled in or drained for farms and factories.

Boats and jet skis can scare away birds, as well as people looking for a quiet spot to enjoy themselves.

Weeds such as cord grass are smothering native plants and animals in some estuaries.

What Can I Do?

Indoor Activities

Draw a food web for an estuary, or make one with drawings joined by bits of string.

Find the godwit's winter home, Siberia, on a map of the world. How far does it have to fly each year?

The names of other New Zealand estuary birds give clues to their winter homes. Try to find on a world map the homes of the Siberian tattler, Asiatic whimbrel, Mongolian dotterel, and Hudsonian (or American) godwit.

Activities by the Estuary

Go bird watching! How many different kinds can you see? What parts of the estuary are they in and what can they do there?

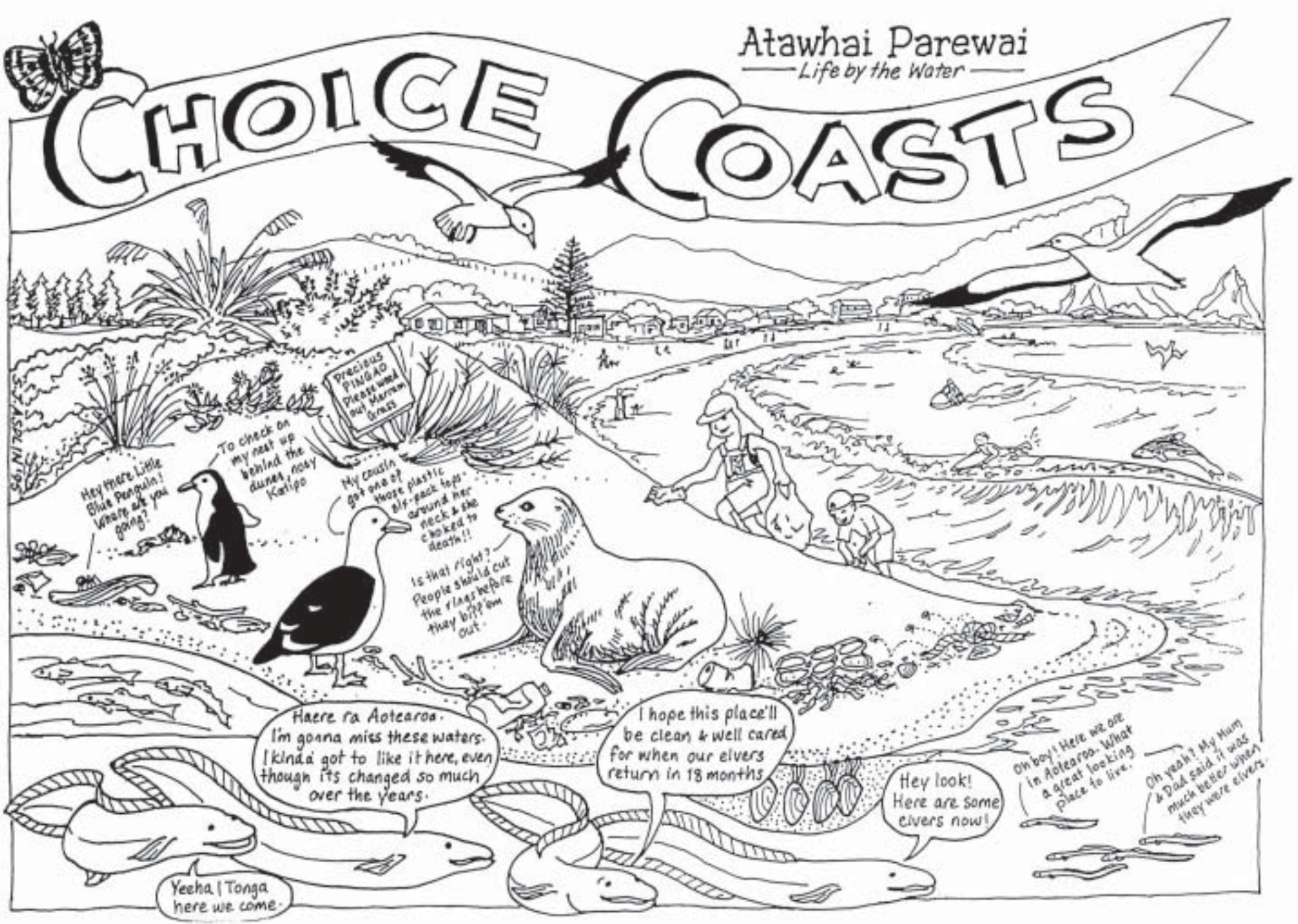
Walk out onto a mudflat and wait quietly for the crabs and other animals to come out of hiding. Watch what they do as soon as you move again.

Discuss what you like about estuaries.

Take in the smells of the estuary. Do you like them? And what does the water taste like?

If you go fishing or shellfish gathering in an estuary, remember to take no more than you're allowed, and only as much as you need for a feed.

Imagine what mudflats are like at high tide when they're covered in water. What animals would be there?


Atawhai Parewai
Life by the Water
CHOICE COASTS
Precious PINGAO Please mind our Marram Grass
Hey there Little Blue Penguin! Where are you going?
To check on my nest up behind the dunes, nosy Katipo
My cousin got one of those plastic six-pack tops around her neck & she choked to death!!
Is that right? People should cut the rings before they bin 'em out.
Haere ra Aotearoa. I'm gonna miss these waters. I kinda got to like it here, even though it's changed so much over the years.
I hope this place'll be clean & well cared for when our elvers return in 18 months
Hey look! Here are some elvers now!
Oh boy! Here we are in Aotearoa. What a great looking place to live.
Oh yeah? My Mum & Dad said it was much better when they were elvers.
Yeeha! Tonga here we come.

Choice Coasts

The Coast Crew – find us in the cartoon!

There are more kinds of penguin in New Zealand than anywhere else. Some live in the few remaining areas of coastal forest or in sand dunes.

Kekeno, the fur seal, were once killed in their thousands around New Zealand, but are now protected.

Karoro (black backed gulls) are well known as rubbish dump scavengers, but they also eat mussels and other shellfish.

Like many fish, yellow eyed mullet feed and breed in estuaries and coastal seas.

Gannets catch fish by plunging straight down at them from 30 metres above the sea!

Hector's dolphin is found only in New Zealand, and is one of the smallest and rarest dolphins in the world.

Tuatua are shellfish that burrow into sand, getting their food and oxygen through siphon tubes.

The beautiful Copper butterfly is one of only 17 native butterflies in New Zealand.

The spiky seed heads of spinifex grass are blown along the beach by the wind.

Katipo spiders live in sand dunes, and the females are well known for their poisonous bite.

Along the tide line, you can find all sorts of things: seaweed, shells, sand hoppers, shags . . . and unfortunately rubbish!

What's Costing the Coast?

Everyone in New Zealand lives less than 130 kilometres from the coast, and most of us live much closer! That means there's less space for our native plants and animals that live on the coastline.Thousands of bits of rubbish are collected from New Zealand's beaches every year. Most of these are plastic from our own homes. Plastics and lost fishing gear can be a killer for seals, dolphins and birds.Weeds like lupin, marram and gorse are taking over a lot of New Zealand's sand dunes. Sand dunes can be ruined by farms and houses, or by people and bikes running over them all the time.

The Story of Pingao

At the beginning of time there was a great conflict between Tane, God of the Forest and his brother Tangaroa, God of the Sea. Tangaroa was jealous of Tane's success in separating Rangi the Sky Father from Papa the Earth Mother.

Tane sought to end the warring between them and as a sign of peace, he plucked out his eyebrows and gave them to Tangaroa. Tangaroa could not find it in his heart to forgive and he threw the eyebrows back onto the shore. There they grow today as pingao, the golden sand sedge, at the boundary between the forest and the sea.

Pingao is found only on the sand dunes of Aotearoa, where its rich golden leaves stand out against the grey-green of the invading marram grass. It traps windblown sand, helping to build the dunes and control erosion. For many years weavers have treasured pingao, using its vibrant colour in tukutuku panelling of meeting houses and for the weaving of kete, whariki and potae. Weeds, farming and settlements have taken over most of our natural dunes and pingao has disappeared from many areas.

What Can I Do?

Indoor Activities

Draw a picture about the Story of Pingao, or make up a short play to perform.

Activities by the Coastline

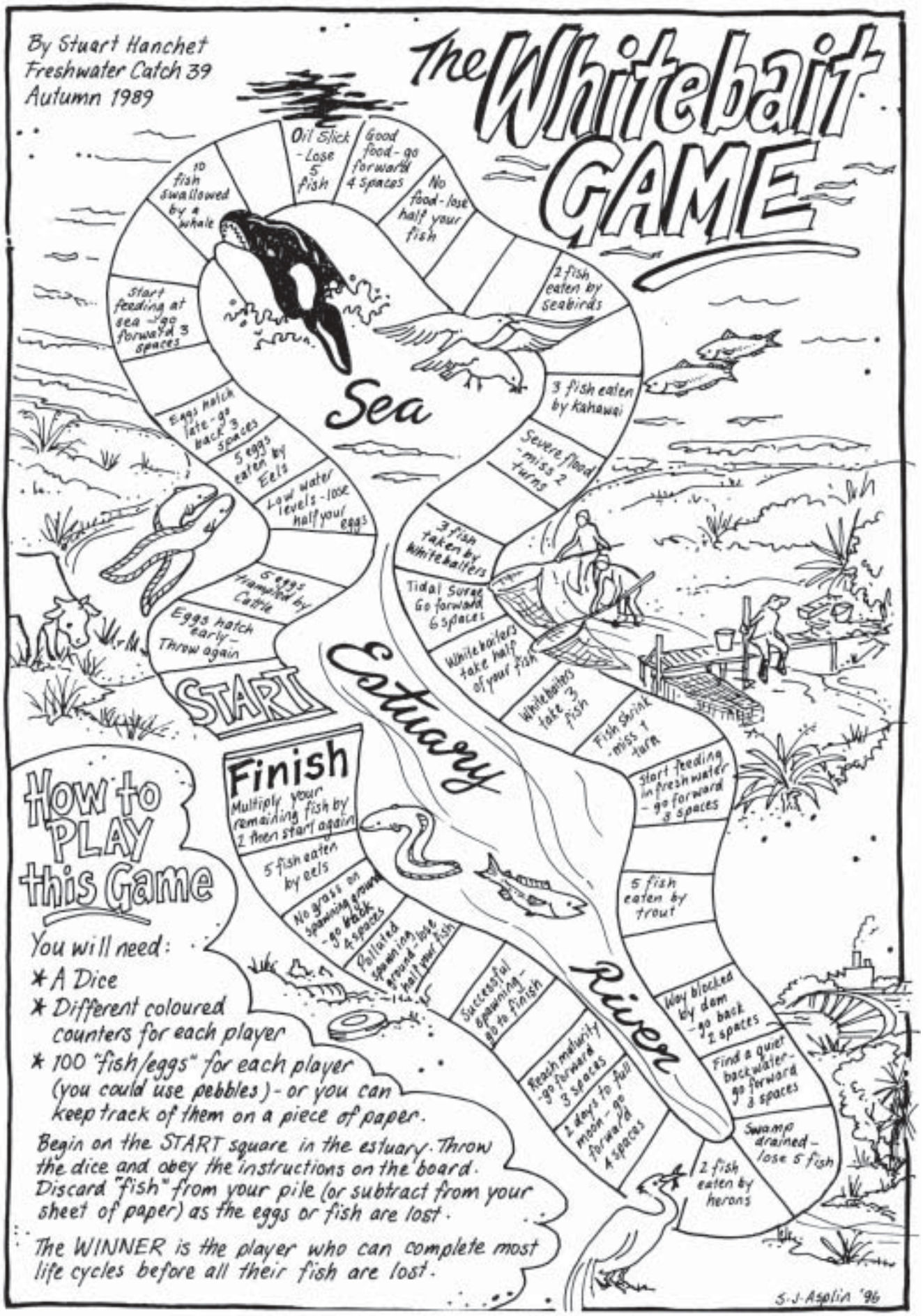
Explore rock pools and sand dunes and list the plants and animals that you find.

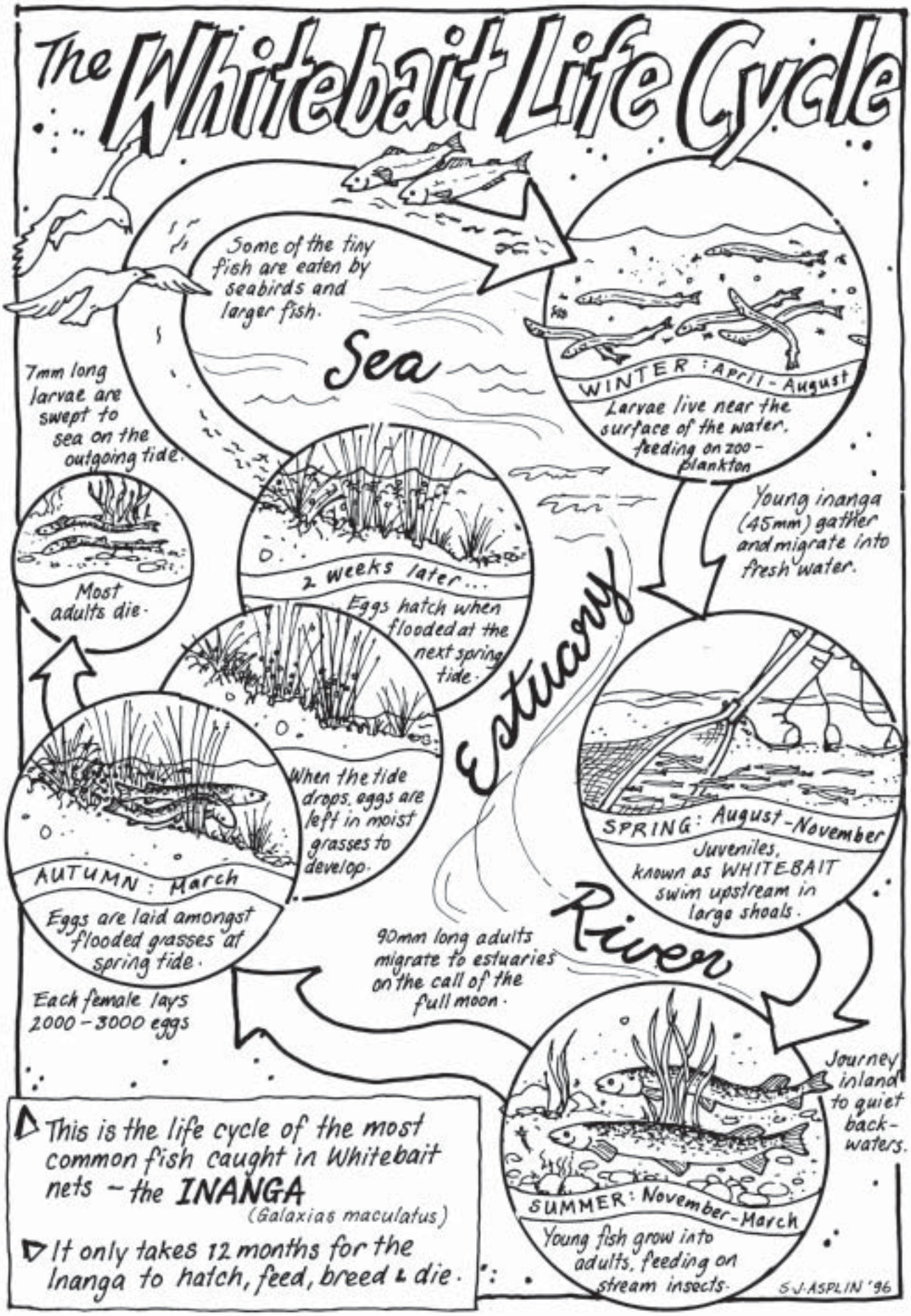
Build sand sculptures – a whale, a face, a turtle . . .

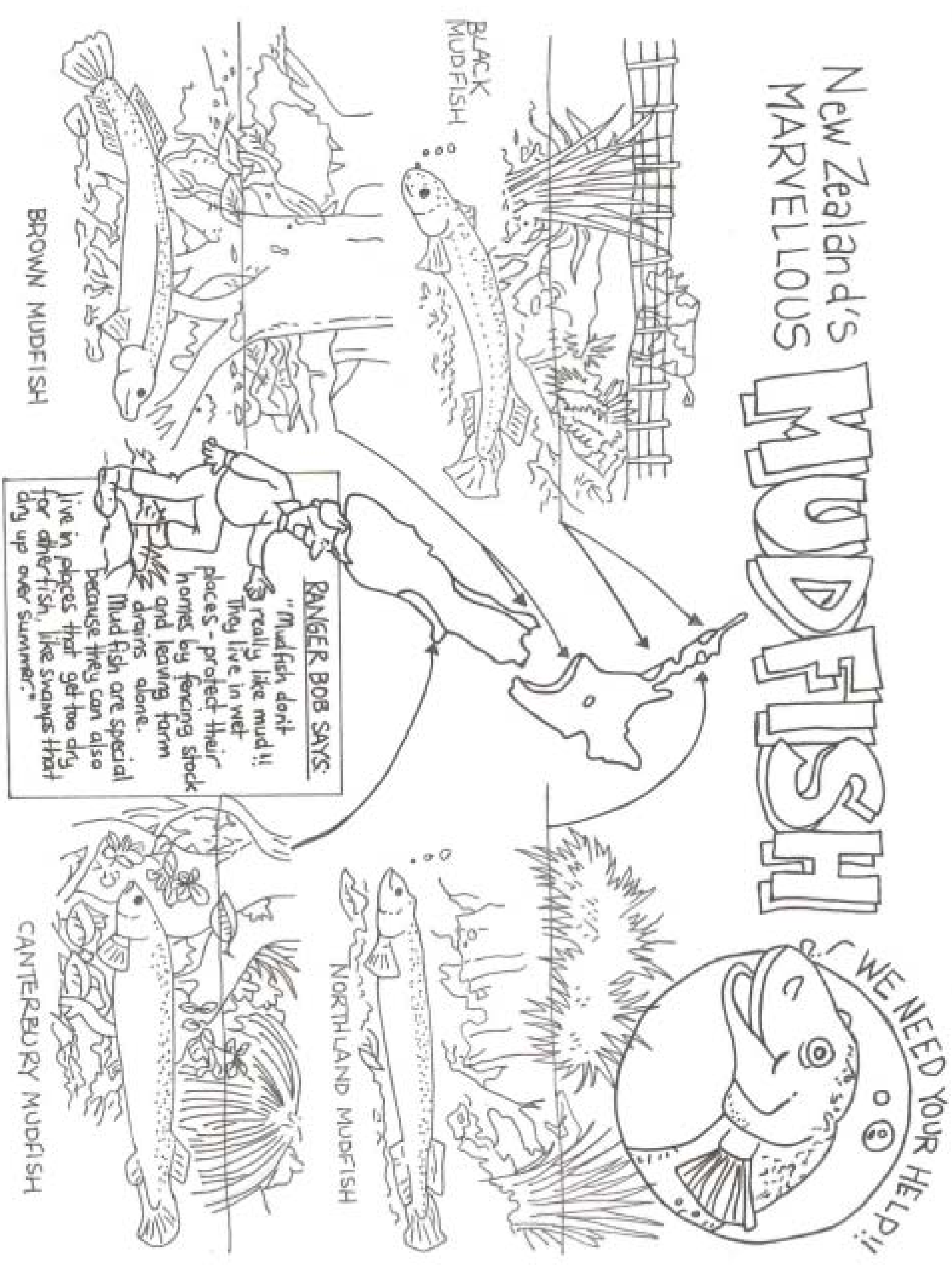
Keep off sand dunes as much as you can, or walk through them carefully. Stabilise tracks through the sand dunes by piling up driftwood from the tide line.

Do a beach clean up – try to figure out where the rubbish came from.

Beat back the weeds by regularly pulling them out or by planting native plants.


By Stuart Hanchet
Freshwater Catch 39
Autumn 1989
The Whitebait GAME
Sea
Estuary
River
START
Finish
Multiply your remaining fish by 2 then start again
10 fish swallowed by a whale
Oil Slick - Lose 5 fish
Good food - go forward 4 spaces
No food - lose half your fish
2 fish eaten by seabirds
3 fish eaten by kahawai
Severe flood - miss 2 turns
3 fish taken by whitebaiters
Tidal Surge Go forward 6 spaces
Whitebaiters take half of your fish
Whitebaiters take 3 fish
Fish Shrink - miss 1 turn
Start feeding in freshwater - go forward 3 spaces
5 fish eaten by trout
Way blocked by dam - go back 2 spaces
Find a quiet backwater - go forward 3 spaces
Swamp drained - lose 5 fish
2 fish eaten by herons
Successful spawning - go to finish
Reach maturity - go forward 3 spaces
2 days to full moon - go forward 4 spaces
Pollated ground - lose half your fish
No grass on spawning ground - go back 4 spaces
5 fish eaten by eels
Start feeding at sea - go forward 3 spaces
Eggs hatch late - go back 3 spaces
5 eggs eaten by Eels
Low water levels - lose half your eggs
5 eggs trampled by Cattle
Eggs hatch early - Throw again
How to PLAY this Game
You will need:
* A Dice
* Different coloured counters for each player
* 100 "fish/eggs" for each player (you could use pebbles) - or you can keep track of them on a piece of paper.
Begin on the START square in the estuary. Throw the dice and obey the instructions on the board. Discard "fish" from your pile (or subtract from your sheet of paper) as the eggs or fish are lost.
The WINNER is the player who can complete most life cycles before all their fish are lost.
S.J. Asplin '96


The Whitebait Life Cycle
Some of the tiny fish are eaten by seabirds and larger fish.
Sea
WINTER: April - August
Larvae live near the surface of the water, feeding on zoo-plankton
7mm long larvae are swept to sea on the outgoing tide.
Young inanga (45mm) gather and migrate into fresh water.
Most adults die.
2 weeks later...
Eggs hatch when flooded at the next spring tide.
Estuary
When the tide drops, eggs are left in moist grasses to develop.
SPRING: August - November
Juveniles, known as WHITEBAIT swim upstream in large shoals.
AUTUMN: March
Eggs are laid amongst flooded grasses at spring tide.
River
90mm long adults migrate to estuaries on the call of the full moon.
Each female lays 2000 - 3000 eggs
Journey inland to quiet back-waters.
SUMMER: November - March
Young fish grow into adults, feeding on stream insects.
S.J. ASPLIN '96
This is the life cycle of the most common fish caught in Whitebait nets - the INANGA
(Galaxias maculatus)
It only takes 12 months for the Inanga to hatch, feed, breed & die.



Artist: Graeme Hotter, hottart@xtra.co.nz

WETLAND WORDFIND

L B M L P I H D Y U N A T I V E V S Y B F L J K N
A A F R E S H W A T E R A S S O M M U N G A H P S
R K G A F I S H I N G T M B C A K C M X F I L S A
U F K O T U K U H S Y W H I T E B A I T O D A T T
T O A E O I P O B C E A Q I S B P R L T L A K P U
A I H N M N T H A E N H G F D J E A U K A D E O R
N A I R A P I R D B F K J B M T L J Y C R U P J A
V Z K W G H K S L P D T Y E A C F A U N A N Q H T
M K A D S A H G J S A L T W A T E R I L E B X A E
S E T A R B E T R E V N I D G N I Z A R G F L R D
I K E T H A M V U Y I O L O E F G D S W N Y D A K
R J A M R E D U C K S H O O T I N G D O I T U K T
U S I O S C B I K L G R F F U M E S L I R G M E Y
O N L M I V A L U A B L E K E V G N I K A Y A K N
T F Z D R A I N I N G P S H F K C K E B E S D E C
X S I C B I A B I R D W A T C H I N G S P O N G E
C C S H A G S Y U S T R E A M T L K O D P M A W S
A M D N C T I J F D S A H E F S A K V F A I O E T
T M R A R M P R O T E C T I O N E C G A S N A T N
C O I N D E S N Y J R S O M A K N T R H I P L L E
H A B I T A T S Q U Y I C K U B O W R E D A Y A I
M N F B R A C K I S H X O P J M P U D F T S G N R
E D B O G H F X O U K S Y E E L K R V O H S A D T
N I S C O M G C L D Y Z J A L D E S T U A R Y S U
T H R E A T E N E D X E U T R O P H I C A T I O N

ACIDIC
AQUATIC
BIRDS
BIRD WATCHING
BOG
BRACKISH
CATCHMENT
HABITATS
HARAKEKE
INVERTEBRATES
KAHIKATEA
KAYAKING
KOTUKU
EUTROPHICATION
FAUNA
FISHING
FLORA
FOODWEB
FRESHWATER
GRAZING
PEAT
PUKEKOS
PROTECTION
RIPARIAN
SALTWATER
SATURATED
LAGOON
LAKE
NATIVE
NATURAL
NUTRIENTS
OYSTER CATCHERS
TOURISM
VALUABLE
WATER
WEEDS
WETLANDS
WHITEBAIT
SHAGS
SPHAGNUM MOSS
SPONGE
STREAM
SWAMP
THREATENED
DISAPPEARING
DRAINING
DUCK SHOOTING
ECOSYSTEM
EEL
ESTUARY

WETLAND WORDFIND

K	A	H	I	K	A	T	E	A	P	V	F	S
B	O	G	N	A	T	U	R	A	L	L	O	P
D	A	T	R	E	T	A	W	K	A	S	O	H
M	S	Z	U	X	N	H	G	X	U	F	D	A
F	T	N	S	K	D	R	A	I	N	I	N	G
S	A	F	H	C	U	B	L	A	G	O	O	N
D	T	J	E	G	W	S	I	P	C	A	B	U
N	I	R	S	K	C	U	D	V	M	D	J	M
A	B	Y	E	S	T	U	A	R	Y	A	P	M
L	A	K	D	A	K	S	W	P	I	H	W	O
T	H	E	Y	Z	M	E	E	L	C	B	U	S
E	E	W	E	K	A	C	E	G	N	O	P	S
W	H	I	T	E	B	A	I	T	Y	T	E	W

BIRDS
KAHIKATEA
WATER
EEL
RUSHES
WETLANDS
HABITATS
SWAMP
DUCKS
NATURAL
WET
FOOD
STREAM
DRAINING
LAGOON
WEKA
FLAX
SPONGE
BOG
KOTUKU
WEEDS
ESTUARY
SPHAGNUM MOSS
WHITEBAIT

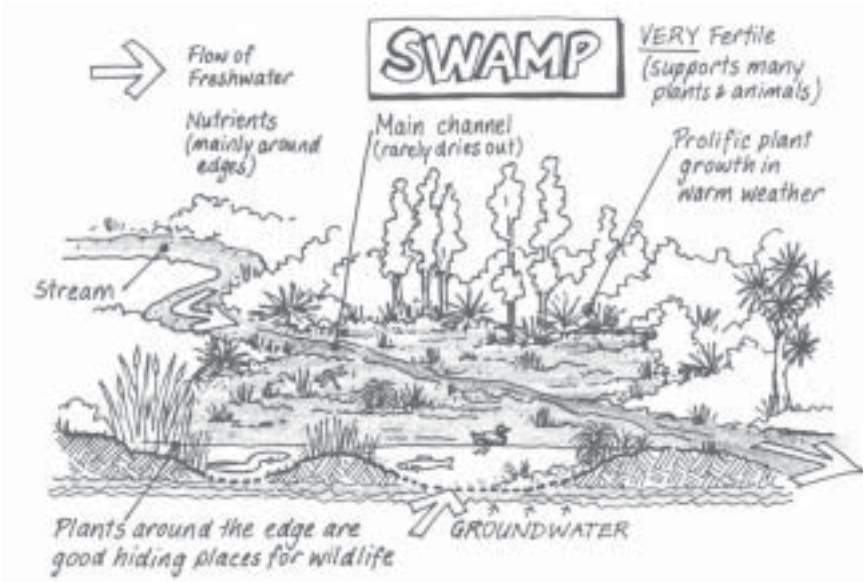
ANSWERS

Answers are only provided for some of the activities. Many of the other answers will vary depending on the age of the children and their experiences. These answers are up to the teacher's discretion.

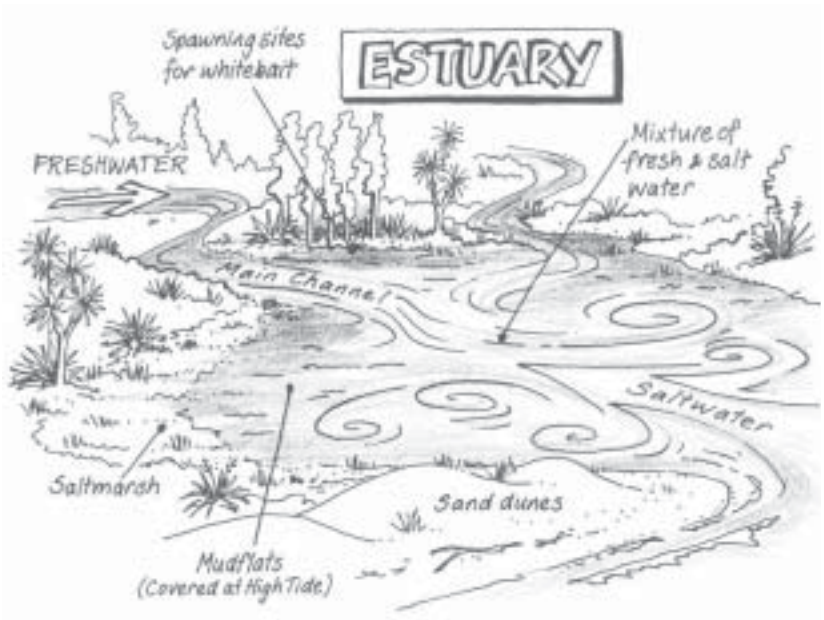
ACTIVITY 1: What is . . . a wetland?

Suggested answers: Bogs have no streams/creeks/rivers running through them; swamps are fed by water from the mountains; estuaries are open to the sea; a lagoon is often close to the sea; a stream can feed or flow through many wetlands.

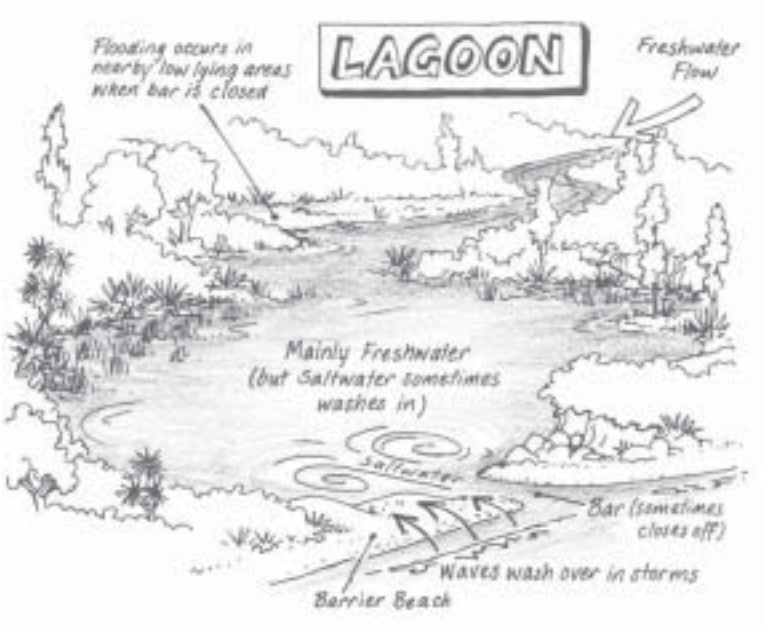
ACTIVITY 2: What is . . . a swamp?



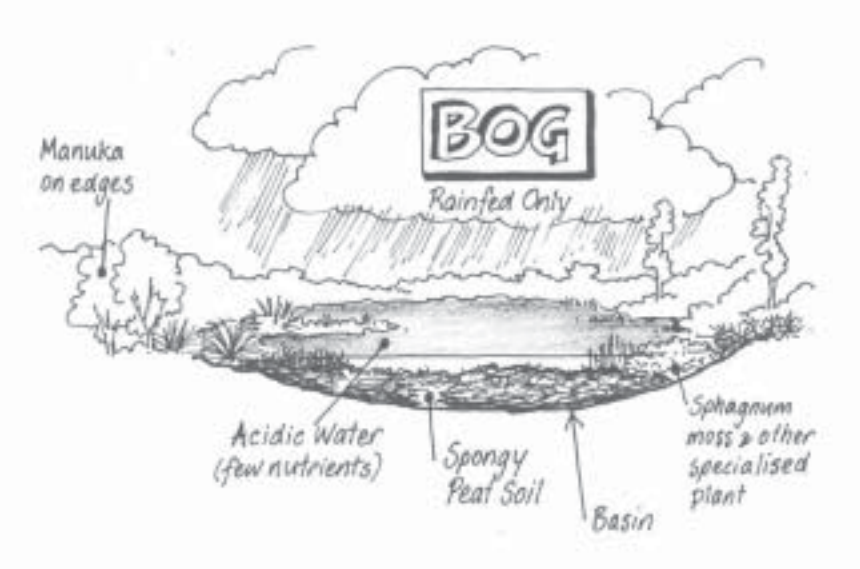
ACTIVITY 3: What is . . . an estuary?



ACTIVITY 4: What is . . . a lagoon?



ACTIVITY 5: What is . . . a bog?



ACTIVITY 6: How Wetlands Change Over Time

1. Trees have been cleared, ground is uneven/lumpy, area is exposed, land is dry.

2. Less water in 2001. There is no creek feeding the pond/lake and has been slowly drying up and filling in.

3. More plants and weeds (gorse), tall trees (rimu and kahikatea) disappearing, water weed on water.

ACTIVITY 7: Wetland Ecosystem

1. Eels, pukekos, kotuku, mudfish, inanga, freshwater mussel, freshwater crayfish, dragonfly nymphs, cabbage trees, kahikateas, flax, native milfoil, rushes, willows (are shown but emphasise that they are weeds and spread very quickly), water boatmen, frogs.

2. A habitat is the place where a plant or animal lives.

ACTIVITY 8: Habitats

(1) In the trees – kotuku. (2) Growing on wet ground – swamp fern, flax.

(3) Hiding amongst plants – bittern. (4) On the water – water boatman, grey duck.

(5) In the water – water milfoil, longfin eel.

ACTIVITY 9: Habitats of Wetland Birds

Habitats 1 – 5: White Heron, Grey Duck. Habitat 5: South Island Pied Oystercatcher. Habitats 1 – 3: Pukeko. Habitat 2: Fernbird. Habitats 3 – 5: Pied Stilt, White Faced Heron. Habitat 4: Black Shag, Scaup.

ACTIVITY 10: Food Chains and Food Webs.

3. Answer to this is the food chains and food web fact sheet on page 37

ACTIVITY 11: Whitebait Life Cycle

1. Live in rivers over summer. Feed and grow into adults. → Adults swim to estuaries to mate in autumn. → Adults lay eggs amongst swampy grasses, then die.

→ Eggs hatch into tiny larvae, swim out to sea to feed over winter. → Return to the rivers in spring as whitebait.

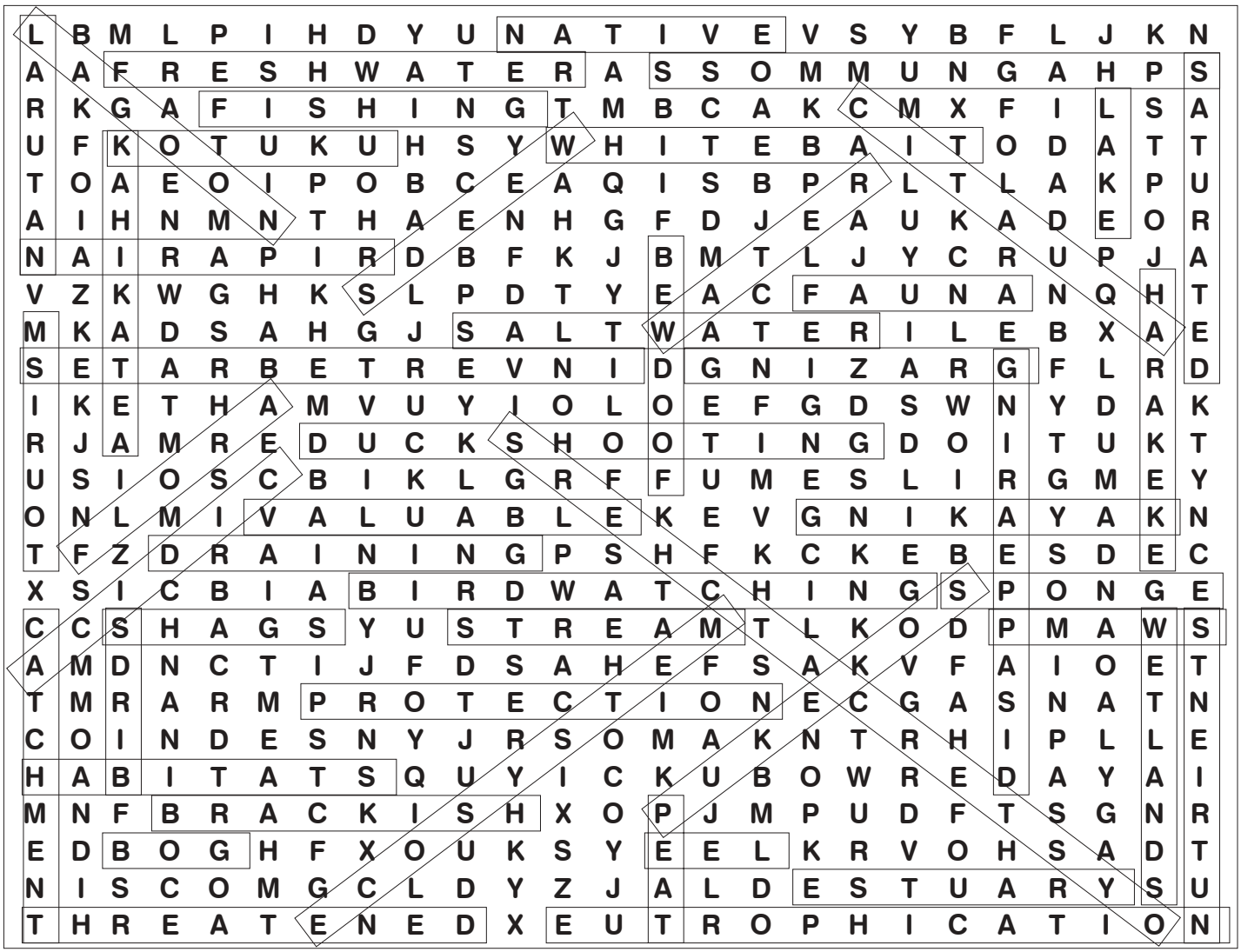
ACTIVITY 12: I spy . . . Fish Identification

Black Flounder – 1 Longfin Eel – 4 Catfish – 5 Common Bully – 2 Banded Kokopu – 3

ACTIVITY 13: I spy . . . Bird Identification

(In correct order from bullet points)

2 – Royal Spoonbill, 1 – NZ Shoveler, 4 – Kotuku, 3 – Pied Oyster Catcher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X S I C B I A B I R D W A T C H I N G S P O N G E
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M N F B R A C K I S H X O P J M P U D F T S G N R
E D B O G H F X O U K S Y E E L K R V O H S A D T
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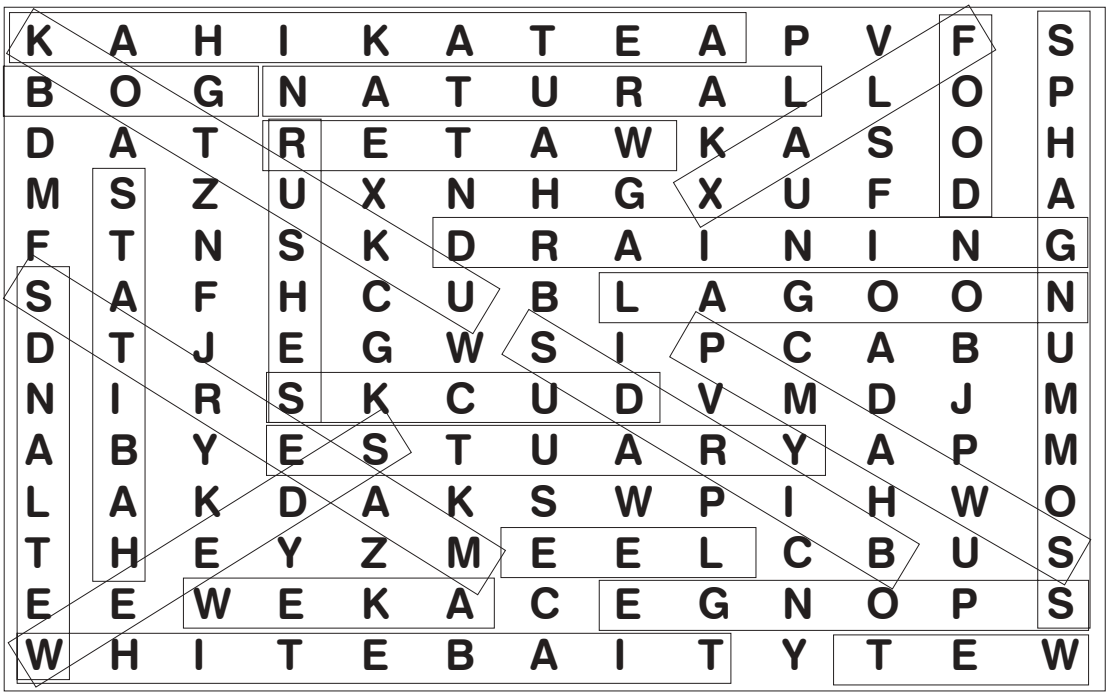
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S A F H C U B L A G O O N
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T H E Y Z M E E L C B U S
E E W E K A C E G N O P S
W H I T E B A I T Y T E W

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