Te Māra Moana

The Living SEA

A Science and Technology Resource for Levels 2 and 3

TEACHERS' GUIDE

TE OHU KAI MOANA

TREATY OF WAITANGI FISHERIES COMMISSION

NEW ZEALAND Fishing Industry Board

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One copy of this resource has been provided free to each primary school. Enquiries about this resource, suggestions for improvements and requests for copies of the English or Māori material of *Te Māra Moana, The Living Sea* can be made to

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CONTENTS

PREFACE

Tēnā koe.

Welcome to the fishing industry.

The industry is now a major force in the New Zealand economy, earning $1,238 million or well over $1 billion in export income in 1995 and directly employing between 9,000 and 10,000 people in catching and processing all over New Zealand.

These figures give some idea of the industry's importance, but fail to capture the full part fishing plays in New Zealand society and culture. The raw employment numbers, for example, do not reveal that fishing keeps alive a string of small coastal communities which otherwise would disappear – and almost every New Zealand family has links with someone associated with the industry.

Fishing helps maintain a link between the new New Zealand and the old, reminding us of times when peoples were more closely in tune with nature, humbly grateful for its bounties and respectful of its power. At the same time, the economic benefits of fishing to the modern economy point the way into the future.

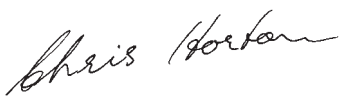
It is important that fishers, scientists and technologists be available to help ensure the sustainability of fisheries as a resource and equip the domestic fishing industry to use that resource effectively.

The New Zealand Fishing Industry Board and Te Ohu Kai Moana, the Treaty of Waitangi Fisheries Commission, have a commitment to support education in fishing science and technology. This kit is one demonstration of that commitment – and its production demonstrates as well a fishing industry partnership between Māori and Pakeha modelled on the Treaty of Waitangi.

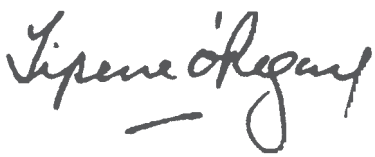
Young people, who are so important to our industry, will learn about fishing from the earliest times when waka went to sea to harvest the fish, a thousand or more years ago, to the present day when trawlers fish our deep sea and inshore waters. They will learn about the life cycles of different fish species, fishing techniques, the importance of ensuring sustainability in managing the ocean's resource and how seafood is harvested and eaten. You will see the role that Māori have played, and will continue to play, in the New Zealand seafood industry.

We hope this education resource will provide you with a comprehensive, informative and useful tool to bring the world of fishing to your students.

Heoi anō



Chris Horton
Chairman
NZ Fishing Industry Board



Sir Tipene O'Regan
Chairman
Te Ohu Kai Moana

INTRODUCTION

Te Māra Moana, The Living Sea is the first in a series of resources about fish and fishing. These resources are produced by the Fishing Industry Board and Te Ohu Kai Moana, Treaty of Waitangi Fisheries Commission to support the teaching of the New Zealand Curriculum.

Te Māra Moana, The Living Sea supports levels 2 and 3 of the science and technology curriculums. It was developed and written by classroom teachers.

One copy of this resource has been provided free to each primary school.

HOW TO USE THE RESOURCE

This resource consists of a set of 12 photographs, which have been chosen to stimulate discussion about fish and fishing, and a teachers' guide. Schools with Māori language immersion classes have been sent a separate teachers' book and a set of 16 research cards in Māori.

Each of the 12 photographs is supported by a section in the teachers' guide which provides:

- focussed starter questions
- a range of activities for students
- relevant background information for teachers
- children's information sheets to copy.

The resource is designed for whole class use and includes suggested group and individual activities.

The children's information pages are provided as OHP and photocopy masters. They provide information to answer the starter questions and to support the suggested activities.

The reporting examples are intended only to provide examples of a range of reporting methods. It is expected that teachers will recognise other reporting opportunities. Assessment suggestions are provided as an example only and teachers will develop assessment relevant to their class's learning programme.

The resource is self-contained. A bibliography of useful resources is included.

There are three exceptional New Zealand videos available to support the material in this resource. They are intended for more advanced levels, but used with direction they are very successful for children at levels 2 and 3. Information on how to purchase or borrow these videos is provided within the relevant sections of the resource and in the bibliography at the end of this book.

Te Māra Moana, The Living Sea is a comprehensive resource on a topic that interests students. There is enough material to support a theme study over at least two weeks.

1. Goldfish

Teachers' notes

Achievement Objectives

Processing and Interpreting:

- identify trends and relationships in recorded observations and measurements by suggesting links between these.

Reporting

- share what they did and what they found out in their investigations in whole class situations or in groups.

Science in the New Zealand Curriculum (Level 2) pp 28, 46 and 47

Questions

Imagine you have just been given these goldfish.

- What do you think would be good about keeping them as pets?
- What would be bad about keeping them as pets?
- What does a goldfish need to stay alive?
- What do you have to do to care for a goldfish and keep it safe and healthy?

Background Information

Goldfish are animals that are very easy to keep in a cold water fish tank in the classroom.

Activities

- Visit a pet shop. Watch fish swimming in the fish tanks. Children could look at the different types of fish and decide which ones they like and why. Look at the equipment you can buy to keep goldfish, and equipment to make a fish tank attractive. Find out what different pieces of equipment are used for. Decide what you need to set up a goldfish tank and work out what it would cost. Ask about how to recognise a healthy goldfish and a sick goldfish.
- Find out how to care for goldfish so they are healthy and live for a long time.
- Children could find out about other animals that live in water that you can keep as pets.
- Keep a goldfish. Set up a fish tank with goldfish in your classroom. Record the water temperature, feeding times and the type of food they are given each day. Keep a record over one week of the behaviour of the fish at different times of the day, including feeding time (for example, actively swimming, slow moving, not moving, feeding at top of tank, feeding at bottom of tank).
- Observe fish swimming. Ask children how they think fish swim. (There is an activity on this in the next section, 'Snapper – Tamure'.)

Suggestions for Reporting

Children could:

- write a poem about what it would be like to be a goldfish kept as a pet and to swim in a fish tank all day
- draw a diagram to illustrate a healthy fish in its tank and an unhealthy fish in its tank. Label the diagram to show what is healthy and unhealthy.
- as a class, discuss the recordings kept on the goldfish. Is there a relationship between feeding and the activity of the fish or water temperature and the activity of the fish?

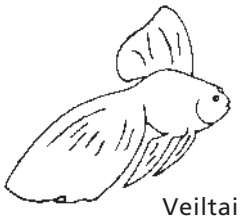
Reference

Caring for your goldfish by L Ruddick (Paradise Press 1986)

Assessment Suggestion

Teachers could assess the children's ability to interpret data in the class discussion on the recordings kept on the goldfish and the suggestions which they make.

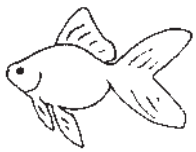
GOLDFISH



Veiltail

Pompon

Comet



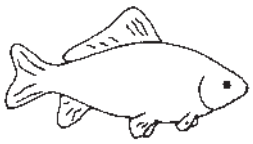
Oranda

Lionhead

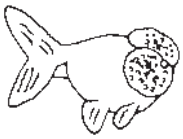
Keeping goldfish

Goldfish live in cold water. They can live for up to 15 years in a fish tank if they are looked after well. In China and Japan people have been keeping goldfish as pets for nearly a thousand years.

Goldfish need to be fed twice a week. They should not be fed more than they can eat in five minutes. Uneaten food falls to the bottom of the tank and decays and makes the water cloudy and bad for the goldfish.



Common Goldfish



Fantail

It is unhealthy for goldfish to live in water that is green and slimy.

Most pet goldfish die from being overfed. If you keep goldfish be careful not to feed them too much.

Goldfish eat prepared fish flakes you can buy from the pet shop. They can eat fresh food like chopped earthworms, or live fish food from a pet shop. They will also eat small amounts of breakfast cereal, bread crumbs or boiled potatoes.

1 Gravel
2 Plastic plant
3 Fish flakes
4 Book about keeping fish
5 Aquarium lid
6 Aquarium
7 Water filter
8 Water ager
9 Catch net

Goldfish like to be in a fish tank where they have lots of space to swim around. Some people keep one or two goldfish in a large bowl, but it is better to give the fish more room to swim in a fish tank.

Goldfish need to get oxygen from the water to breathe. In a bigger tank more oxygen gets into the water. People sometimes put a pump into the fish tank so that extra oxygen gets into the water.

Some people regularly take out about one third of the water in the fish tank and put in clean water. They make sure the new water is the same temperature as the water in the tank. Some people put a filter in their aquarium to keep the water clean.

People put clean pebbles in the bottom of the fish tank. You can grow plants in fish tanks or put in plastic plants, plastic boats or animals, or shells.

2. Snapper – Tāmure

Teachers' notes

Achievement Objectives

Making Sense of the Living World:

- distinguish between living things within broad groups on the basis of differences established by investigating external characteristics;
- investigate special features of common animals and plants and describe how these help them to stay alive.

Science in the New Zealand Curriculum (Level 3) p 58

Questions

- What does this snapper do all day?
- What does it eat?
- What eats the snapper?
- What would happen if we took these snapper out of water?
- Why do fish need water?
- How do fish move through the water?
- How do you think this snapper would escape from bigger fish or sharks?
- Do fish have bones?
- What does a fish feel like to touch?
- How old do you think these snapper are?

Activities

- Watch fish swimming in an aquarium, at a pet shop or on a video. Children could draw a fish swimming and describe what they think is happening. Look at the copymaster 'How Fish Swim'. How good were their observations? (Many people guess that fish swim using their fins.) Children could draw a new picture of how fish swim and describe the fish swimming. Watch fish swimming again and work out how the fish change direction, stop and go backwards.
- Buy a snapper or obtain another whole fish. Feel the skin, scales, fins, teeth and eyes and find the skeleton, gills and gut. Children could label a drawing of the outside and inside of the snapper, identify the parts and say what each part does.
- Children can look at a fish scale using a magnifying glass and draw the pattern they see.
- Children could gather pictures of animals they know live in the sea. Put the animals in groups and compare how they grouped them. Decide as a class which animals are fish and why. What are the names of other sea animals or groups of sea animals they have pictures of (for example, dolphins, starfish, crabs)?
- Display the *New Zealand Commercial Fish Species* poster from this kit. Discuss as a class what features all fish have and list them. Predict which fish are fast swimmers and which fish are slow swimmers. Why do they think so? Discuss which fish might live in deep and shallow water.
- Read copies of the student section about snapper. In groups, work out a food chain which includes snapper. Make a mobile of the food chain. Children could make the sea animals by drawing each side of an animal, glueing and stapling the pieces together, stuffing with newspaper and decorating.

Suggestions for Reporting

Children could:

- in pairs, compare their drawings of how fish swim. How good were their predictions? Was it difficult to work out how fish swim?
- display their drawings of the inside and outside of the fish, and of fish scales seen through a magnifying glass
- use the mobile of a snapper food chain to describe to the class a food chain involving snapper.

Assessment Suggestion

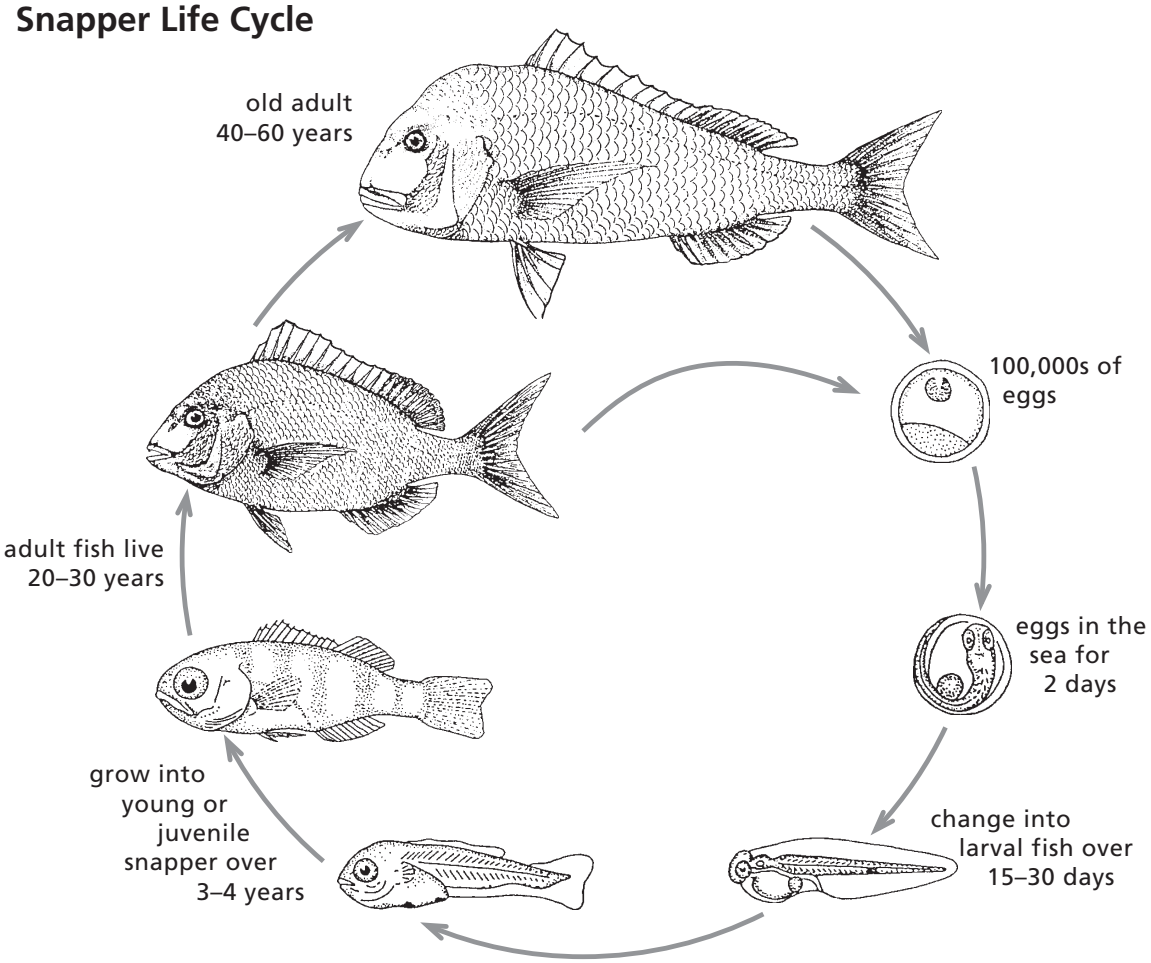
Teachers could assess the children's observations of a part of a fish and ability to draw what they see in their drawings of fish scales seen through a magnifying glass.

Background Information

Snapper are caught commercially by long lining, set netting and inshore trawling. There are limits set on the number of snapper both recreational and commercial fisherpeople can catch to ensure that the population numbers of snapper are maintained.

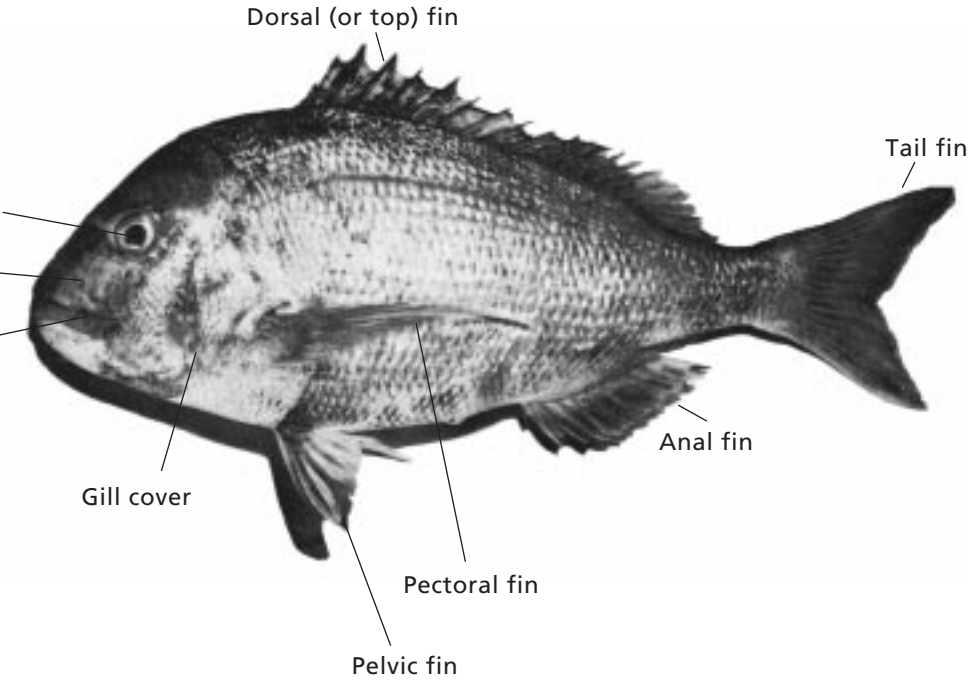
Adult snapper are usually between 30–50 cm long and weigh between 1.5 kg and 2.5 kg. A very old snapper could live to be 60 years old, grow to one metre long, and weigh at least 16 kg. Old snapper look very different to young adult snapper.

Snapper Life Cycle



A female snapper produces between 200,000 and 5 million eggs per year. Only two of these have to survive through to a mature adult to maintain the stock. Three or more surviving through to adulthood will increase the stock. The eggs and young fish may be eaten, or may die from lack of food or disease.

SNAPPER – TĀMURE



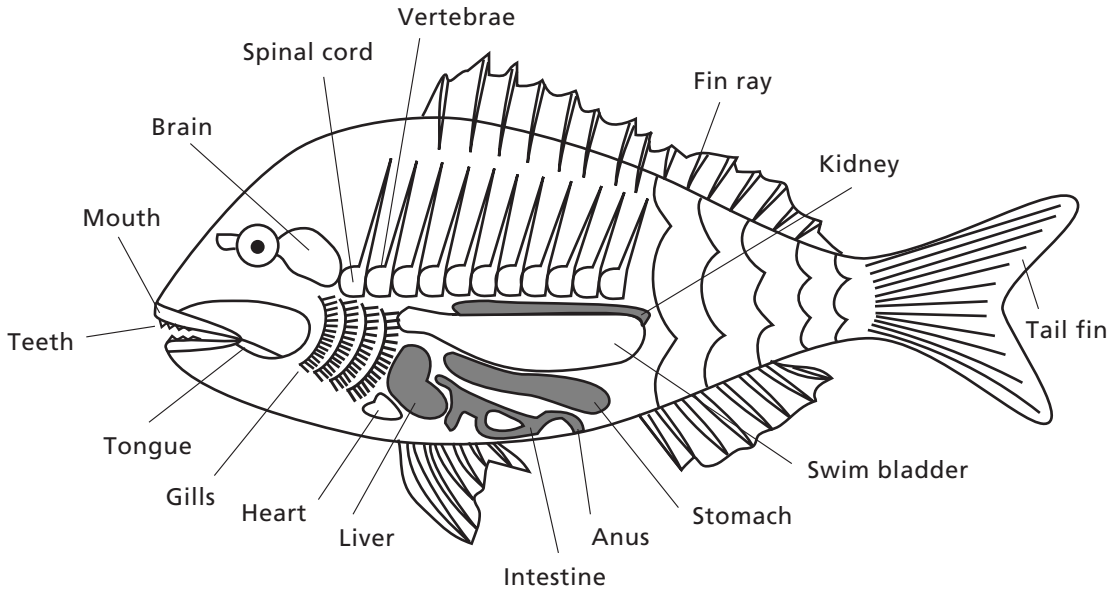
All about snapper

Snapper are fish that live in the sea around the North Island and the northern part of the South Island. They have a Māori name, tāmure. They have a scientific name, *Chrysophrys auratus*. They are coastal fish that live 20 to 100 metres down on a muddy or sandy sea floor.

Snapper eat shellfish, sea urchins, crabs, worms and dead animals on the sea floor. They can also eat small living fish. They have rounded teeth to crush their food.

When they are eggs or small fish they are eaten by bigger fish. Adult snapper are eaten by people. Snapper are a traditional seafood eaten by Maori.

Snapper are suited or adapted to living in the sea. Their body shape and fins help them to swim fast. A snapper can swim at 8 km per hour for short bursts, and 2.5 km per hour for longer periods.



Living in the sea

Snapper have a tough skin covered with scales on the outside.

Snapper can see well in the water and we think they see in colour, and they also have a sense of smell. They know where they are and what is in the water around them because they feel vibrations in the water.

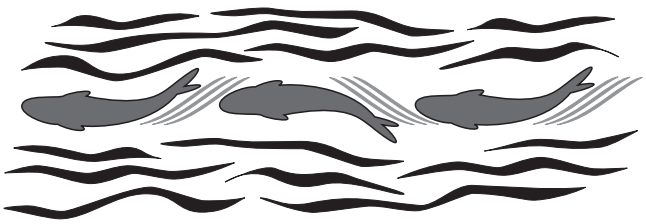
Snapper need oxygen and food to get energy to move and live. They take oxygen out of the water. They swallow mouthfuls of water and push the water out of their gills.

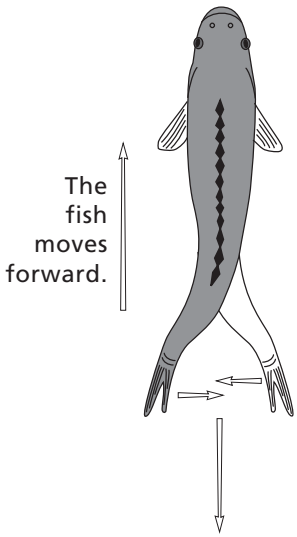
Snapper spend most of their time looking for food. They spend time resting, swimming, looking for mates and spawning (producing eggs), and avoiding being caught. Snapper avoid being eaten by staying camouflaged in hiding places on the rocky bottom of the sea.

Like other fish and sea animals, there are rules about how many snapper people can catch so there will always be enough for the future.

HOW FISH SWIM

A fish is a good shape to move through water.



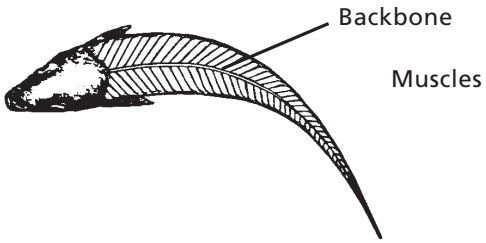


A fish moves forward when the tail and tail fin are moved from side to side.

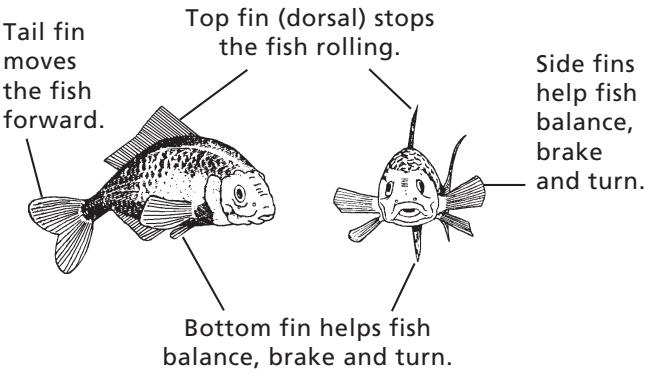
This is a picture of a fish seen swimming from above.

The fish moves forward because its tail pushes back against the water.

Inside the fish is a skeleton of bones. Between the backbone and the skin of a fish are its muscles. These muscles move the tail from side to side. Muscles are the part of the fish that we eat.



Fish use their fins to help them swim straight, stop, change direction and go backwards.



3. Rock Lobster – Kōura

Teachers' notes

Achievement Objectives

Making Sense of the Living World:

- use differences and similarities in external characteristics to distinguish broad groups of living things;
- investigate and understand the general functions of the main parts of animals and plants;
- investigate and understand the changes that take place in animals and plants during their life cycles.

Science in the New Zealand Curriculum (Level 2) p 56

Questions

- What sea animal is this?
- Imagine you had a hard outside like a suit of armour you couldn't take off. How would you move, or grow bigger?
- Why do rock lobster or crayfish have a hard skeleton on the outside?
- How does a rock lobster move?
- How does a rock lobster grow bigger?
- What do rock lobster eat?
- How do people catch rock lobster?
- How do rock lobster make it difficult for people to catch them?

Activities

- Use extracts from the video *Tale of the Crayfish* without the sound track to demonstrate the life of a crayfish, or copy and use the student information section 'Rock Lobster – Kōura'. As a class discuss a day and a night in the life of a rock lobster.
- Look at the copymaster 'The Life Cycle of a Rock Lobster'. View the video. Discuss the stages in the life cycle. How do scientists find out about the life cycle of a sea animal like a rock lobster?
- The children could discuss how to catch rock lobster and why you can't take as many as you like on any one day. Discuss why you cannot take a female rock lobster which is carrying eggs from the sea. Why do we return undersize rock lobsters to the sea?
- As a class, work out the advantages of having an outside skeleton.
- Discuss other animals, including other animals that live in the sea, and decide if they have exoskeletons or inside skeletons.

Suggestions for Reporting

Children could:

- draw a cartoon of a day and a night in the life of a rock lobster
- write a story about a rock lobster whose exoskeleton is too small and has a lucky escape when it goes into a crevice to moult
- summarise the discussion on not taking rock lobsters in berry (with eggs) on the blackboard.

Assessment Suggestion

Teachers could assess the children's ability to interpret information about a life cycle to explain why we don't take female rock lobsters when they are carrying eggs.

Reference

Tale of the Crayfish is a good video to support this section. This is available on loan from National Library School Libraries 2000 centres. It can also be borrowed from the Department of Conservation. It can be purchased from TVNZ for $100 plus GST.

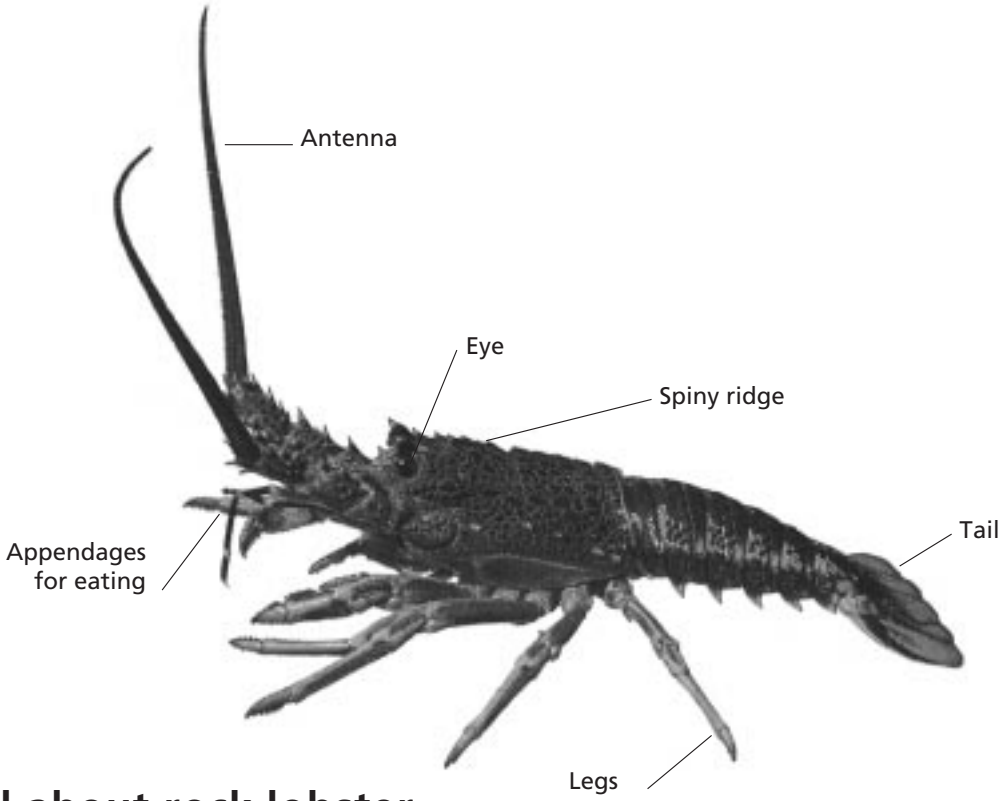
Background Information

Crayfish are increasingly becoming known by the name rock lobster. This is what they are sold as overseas.

Animals with exoskeletons have their flesh, body parts or muscles protected by an outside skeleton. Their muscles attach to the inside of the skeleton. Animals with an inside or endoskeleton have muscles attached to the outside of their skeletons.

Animals with exoskeletons cannot grow very big.

ROCK LOBSTER – KŌURA



All about rock lobster

Another name for rock lobster is crayfish and the Māori name for rock lobster is kōura. It has a scientific name *Jaxus edwardsii*. Rock lobster are found in caves or crevices on the bottom of the rocky sea floor all around New Zealand.

Rock lobster stay safe inside their caves during the day and come out to feed at night. They eat cockles, pāua, mussels and shellfish, and sometimes dead and decaying fish and shellfish. Rock lobsters have appendages or limbs around their mouth to tear off bits of food and put them into their mouths.

Rock lobster need to know what is going on around them. They have eyes that stick up on stalks and antennae that wave about and detect what is happening in water. They have a strong sense of smell.

Rock lobster can swim backwards but mostly they walk along the sea floor.

A rock lobster must lose its hard shell to grow bigger. This is called moulting. The rock lobster goes into a cave or crevice and moults. Underneath is a new larger soft shell. The rock lobster must stay hidden for the next few days until the new shell gets hard. If a rock lobster has lost a leg or antenna it will grow new ones when it grows its new shell.

Catching rock lobster

Rock lobster are caught in craypots because they are attracted to the dead fish that is put in the pots. Rock lobster are also caught by snorkellers, and divers who find their hiding places and pick them up. Rock lobster are a traditional seafood eaten by Maori.

If you catch rock lobster you need to know about the legal limits on the size they must be before you take them.

A rock lobster will be 5 to 10 years old when it is large enough to be caught. No-one can take a female rock lobster from the sea if it is carrying eggs.

Like other sea animals and fish, there are rules about how many rock lobster people can catch so there will always be enough left in the sea for the future.

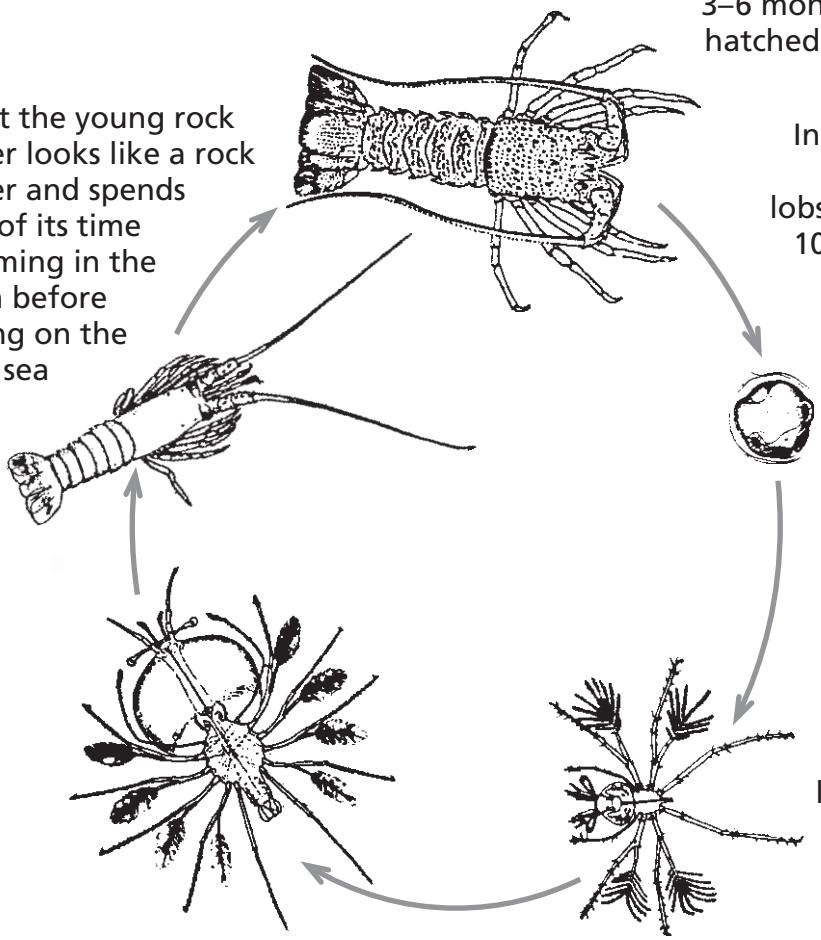
THE LIFE CYCLE OF A ROCK LOBSTER

Rock lobster have a very strange life cycle or life history.

It takes 3 to 7 years to become an adult rock lobster.

Adult rock lobsters are up to 60 cm long and can live to be 40–50 years.

Each year after mating up to 500,000 eggs develop on the tail of each female adult rock lobster. Each egg is 1 mm across. The eggs are attached to the female for 3–6 months and then hatched into the sea.



At last the young rock lobster looks like a rock lobster and spends most of its time swimming in the ocean before settling on the rocky sea floor.

In its lifetime a female rock lobster produces 10,000,000,000 eggs.

Only 2–3 of these eggs become adult rock lobster.

The eggs change into this strange looking creature. It is about 2 mm long. It floats and swims in the sea.

At the end of the 12–24 months it looks like this and is about 4 cm long. This small animal is found hundreds of kilometres from shore.

4. Pāua

Teachers' notes

Achievement Objectives

Making Sense of the Living World:

- investigate and understand the general functions of the main parts of animals and plants (Level 2);
- investigate special features of common animals and plants and describe how these help them to stay alive (Level 3).

Processing and Interpreting

- with teacher support, use their findings to suggest an answer to their selected questions and problems and make a simple evaluation of their investigation (Level 2).

Science in the New Zealand Curriculum p 47, 56 and 58

Questions

- What do you think is happening in this picture?
- How does a pāua move?
- How fast do you think it can move?
- How does it protect itself from fish, starfish or other animals that want to eat it?
- What does the pāua eat?
- How does it eat?
- What are the holes in a pāua shell for?

Activities

- Show extracts from the video *The Life of the Pāua* or use the student information section 'Pāua'. Discuss what it is like to pull a pāua off a rock. Discuss how the pāua escapes from its enemies.
- Pāua are closely related to snails. The way they move is the same as a snail. A muscular foot ripples or contracts to move the animal forward. Children can watch how snails move by looking through a piece of glass at a moving snail.
- Pāua are herbivores (they eat plants). Discuss the terms herbivore and carnivore and have children work out three food chains that have pāua in them. Use the student information section 'Pāua' for more information. What additional information would they need to extend the chains?
- Have children bring pāua shells, polished pāua shells or pāua jewellery to school. Examine a pāua shell. Discuss possible reasons why tourists like pāua shells and jewellery so much.
- Use inks or dyes to make pāua patterns.

Suggestions for Reporting

Children could:

- write a short report to describe how pāua and snails move
- draw sea creatures in a rockpool and connect plants and animals in a food chain by drawing a line between them
- design a piece of pāua shell jewellery.

Assessment Suggestion

Teachers could assess children's observation and understanding of how snails and pāua move as demonstrated in their written reports.

Reference

The Magic of Pāua is a good video to support this section. This is available on loan from National Library School Libraries 2000 centres. It can be purchased for $75 plus GST from C Thomas, NIWA, PO Box 14-901, Kilbirnie, Wellington, phone 04 386 0300 fax 04 386 1574.

PĀUA

All about pāua

Pāua is a Māori name. In other parts of the world pāua is called abalone.

Pāua is found in rock pools and in shallow water around the coast of New Zealand.

The hard shell of a pāua protects it. The pāua uses its foot to clamp onto rocks. Animals that want to eat the pāua can't get through the shell, and they can't pull the pāua off the rocks.The pāua must grow its hard shell. The outside is a thin tough white layer, the inside is smooth and coloured. The pāua has gills to get oxygen out of the water.

Pāua are closely related to snails. The way they move is the same as a snail. A muscular foot ripples or contracts to move the animal forward. The pāua mostly moves about at dawn and dusk to find food. When it is moving and eating it is slightly raised off the rock and can be caught and eaten if it does not clamp quickly back onto the rock.

Pāua are herbivores – they only eat plants. The pāua eats seaweed.

Pāua release eggs into the sea through the line of holes in the shell.

Pāua eggs are eaten by fish. Small pāua are eaten by shrimps, fish, starfish and rock lobster. Large pāua are eaten by starfish, rock lobster and people. Pāua is a traditional seafood of Maori. Many people like to eat pāua and we sell frozen and canned pāua overseas. Pāua shell is collected by people and used in jewellery.

You can only snorkel to collect pāua, you are not allowed to scuba dive to collect them.

Like other sea animals and fish, there are rules about how many pāua people can catch and what size they must be, so there will always be enough left in the sea for the future.

5. Going Fishing

Teachers' notes

Achievement Objectives

Making Sense of the Nature of Science and its Relationship to Technology:

- investigate and describe how simple items of technology work;
- |investigate the way common items of technology have developed.

Science in the New Zealand Curriculum (Level 2) p 28

Questions

- What equipment are these people using to catch fish?
- Why do the fish swallow the hook?
- Do you think it hurts the fish?
- What will happen to the fish these people catch?
- Can they catch as many fish as they want?
- What do they do with small fish or fish they don't want?
- How do they keep the fish they catch fresh?
- What other things get caught on fishing lines?
- What safety equipment should you take with you on a boat?

Activities

- Children could survey local fishing. Draw a large map of your local area. Children could ask their parents or friends where people go fishing or gather seafood, and what sorts of fish and seafood they catch. Using illustrations or symbols, display this information on the map. Find out if there are any areas that are too dangerous to fish or gather seafood and put this information on the map. Find out if there are any areas that are too polluted to fish or gather seafood and put this information on the map.
- Contact a local sports shop or fishing supply shop. Students could find out what limits there are on the fish and shellfish people can take in your area. Find out if you need a licence to fish for some fish in your area.
- A survey showed that around one million New Zealanders (or one in three) goes recreational fishing at least once a year. Discuss why people like to go fishing.
- Have children design a class survey on fishing. They could ask questions like: do you go fishing, do you like fishing, do you own any fishing tackle such as a rod, fish hooks or a net, what fish do you catch, do you keep them or throw them back, what do you do with the fish you catch?
- Invite someone who goes fishing to talk to the class about fishing. Ask them to bring their fishing gear and explain about the equipment they use to catch different fish.
- Children could find out about different sorts of fishing equipment and the fish it is used to catch from sports shops, libraries and family or friends.
- Most people who go fishing have a fishing story. Children could tell fishing stories or listen to a great fishing story from a friend or someone in the family or community. They could tape record a story and play it to the class.

Suggestions for Reporting

Children could:

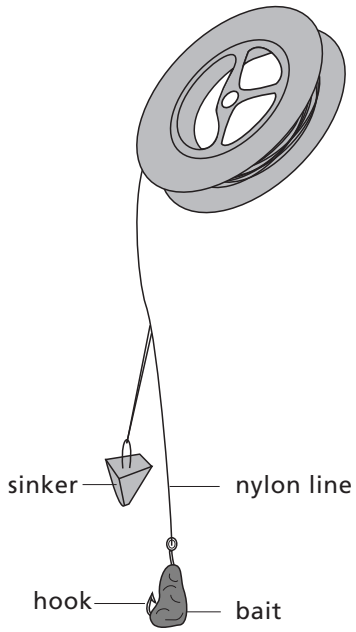
- display the results of the class survey on fishing on a chart
- write and illustrate a report on different sorts of fishing equipment
- play recorded fish stories to the class.

Assessment Suggestion

Teachers could assess the children's ability to develop research questions for the class survey in a class discussion.

GOING FISHING

Fishing with a handline

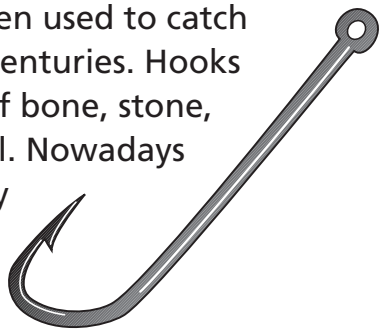


You can use a handline to fish off a boat, a wharf or rocks. A handline has a line, a hook and something to wrap the line around so it won't get tangled. The line needs to be strong so it won't break when pulling in a fish that is trying to get away.

A sinker is a piece of lead that is tied to the line. It makes the line heavy so it will sink down in the water. A lure can be tied to the line. The lure may be shaped like a fish or squid and is shiny. The fish think it is another fish.

Hooks

In New Zealand and overseas hooks have been used to catch fish for many centuries. Hooks can be made of bone, stone, wood and shell. Nowadays they are mostly made of metal.



Bait is put on the hook. Bait is a small piece of the sort of food fish like to eat. It may be shellfish, pieces of fish, maggots, worms or pieces of bread. When the fish eats the bait it swallows the hook.

Fishing with a fishing rod

You use a fishing rod to make the line go a long way out into the water and a reel to let the line out and pull it in again. Rods can bend a long way so heavy fish won't break them.

Catching fish and gathering seafood

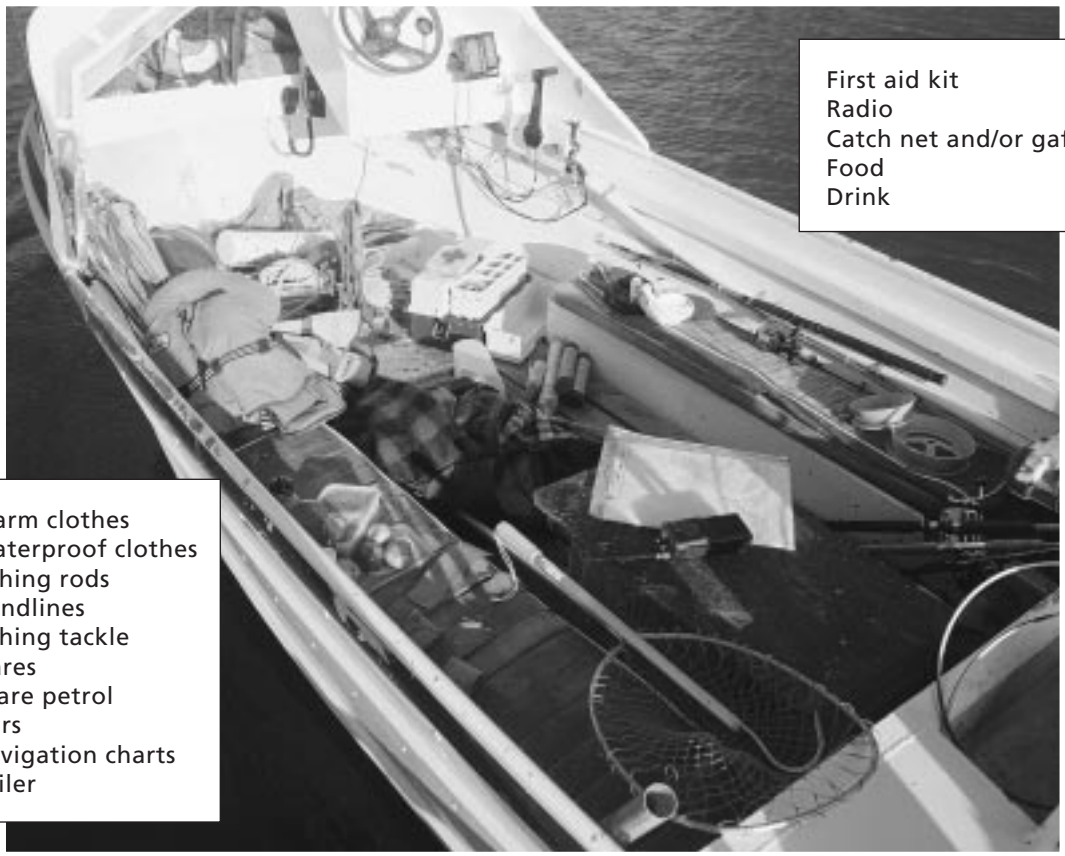
You should not collect seafood or go fishing in polluted areas. The worst type of pollution is sewage. Sewage is the waste that goes down the toilet. Fish and shellfish that come from areas where there is sewage in the water can make us sick if we eat them. Always look out for signs like these.

Some people who fish know a lot about where to go to catch certain types of fish, what time of day to fish, and when the tide is right for fishing.

Once it is caught fish is kept cold, often in a chilly bin, so it stays fresh till it is ready to be eaten.

There are rules about how many fish and other sea animals people can catch so there will always be enough left for the future.

Safe fishing from a boat



First aid kit
Radio
Catch net and/or gaff
Food
Drink

Warm clothes
Waterproof clothes
Fishing rods
Handlines
Fishing tackle
Flares
Spare petrol
Oars
Navigation charts
Bailer

You need to take these things when you are fishing off a boat to keep yourselves safe, and to catch fish.

6. Fishing off a Trawler

Teachers' notes

Technological Area: Structures and Mechanisms

Context: Business

Achievement Objectives

Technological Capability:

- gather and collate information on needs and opportunities in the local environment.

Technological Knowledge and Understanding:

- explore and describe how components are linked in a technological system.

Technology and Society:

- describe and identify the positive and negative effects of some instances of technologies on people's lives and the environment.

Technology in the New Zealand Curriculum (Level 3) pp 32, 36 and 42

Questions

- What is happening here?
- Why do these boats go to sea?

The boat could be out at sea for 35 to 40 days at a time. They work 24 hours a day in calm and rough weather.

- What do you think it would be like to work on a fishing boat?
- What sort of person do you think a person who fishes for their living would be?
- What would they need to take on the trawler if they stay out at sea for a month?
- How far do you think the boat might travel in one month?
- Where do they keep all the fish that is caught during the month?
- If you were going out on this boat for a month what would you take?

Activities

- If you live near a fishing port you could visit a trawler. Children could develop questions about living on a trawler. What is it like living at sea? How do they catch the fish? What equipment is there on a trawler? They could take photographs or make drawings of the visit.
- Children could predict the sequence for catching fish and processing it on a trawler and discuss their reasons for their predictions. They could find out how trawlers catch fish and check their predictions.
- Write a diary of a day in the life of a deckhand after they have been out at sea for three weeks.
- Conduct research into the different types of trawler nets, what they are made of and what they catch.
- Children could design a mechanical pulley system for dragging in nets. They could find out about different types of pulleys, decide what weight they want their pulley to raise (for example, 1 kg), and investigate the differences between pulleys made of different types of materials.

- Make a model trawler out of a shoe box. Children could use fruit bag netting to make a net, cardboard for doors, polystyrene balls for floats and washers for bobbins. They could demonstrate how trawlers catch fish using their models.

Suggestions for Reporting

Children could:

- show their pulley systems to one another and identify any problems they have using them and possible modifications
- make flow diagrams of their predictions for a sequence of activities on a trawler and their findings about how trawlers fish
- in groups, read their trawler diaries.

Assessment Suggestion

Teachers could assess children's understanding of the linked components in a technological system in their description of the process of catching fish on a trawler.

Reference

Fish, a Country Calendar programme which looked at life on board the deep sea trawler *Amatal Colombia* is available for loan from National Library School Libraries 2000 centres. It can also be purchased for $110 plus GST from TVNZ.

The video *Orange Roughy*, produced by NIWA, is also available from National Library School Libraries 2000 centres. It contains useful material but for this age group may be best shown without sound. It can be purchased for $75 plus GST from C Thomas, NIWA, PO Box 14-901 Kilbirnie, Wellington, phone 04 386 0300 fax 04 386 1574.

The Country Calendar programme *Orange Roughy* is also available from National Library School Libraries 2000 but this programme is less suitable for this age group.

Background Information

This section covers one type of trawling for one deep sea species, orange roughy. If you live in an area with an inshore fishery you could find out about the types of fishing boats and methods of fishing carried out in your area.

Since 1978, a numer of separate fishing grounds for orange roughy have been established within the 200 mile Economic Zone that New Zealand manages. These fisheries are deep water fisheries some distance from the coast. The orange roughy fishery is a fishery managed by the Quota Management System.

The companies that fish for orange roughy buy or rent quota that allocate them a set percentage of the yearly total allowable commercial catch of orange roughy. The Total Allowable Commercial Catch (TACC) is set each year by the Minister of Fisheries after assessment of the fishery by scientists and the industry.

FISHING OFF A TRAWLER

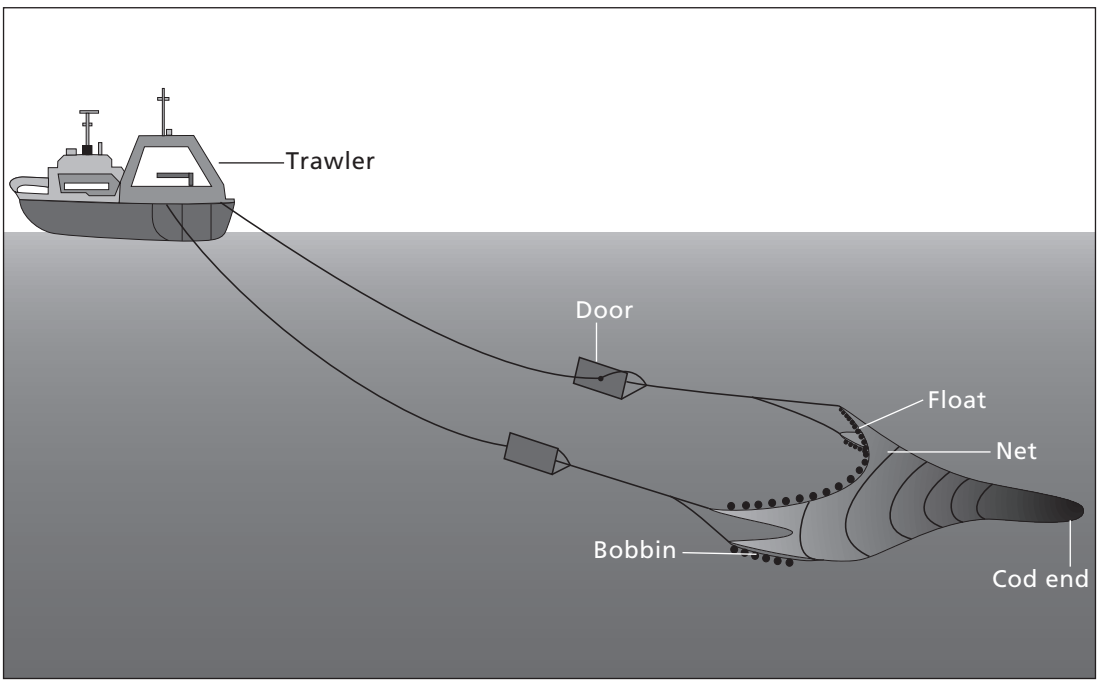
Catching fish from a deep sea trawler

A trawler is a commercial fishing boat. The one in the photograph is 54 metres long and weighs 1200 tonnes. All the people on the boat earn money by catching and selling fish.

The trawler can catch a fish called orange roughy using this net. Orange roughy live in very deep water. To catch the fish the trawler crew release the nets into the water. It takes 30 minutes for the net to reach the seafloor. The net looks like this.

The doors hold the net open and push fish into the net. The floats hold the net up and open. The bobbins help the net ride over the rough sea floor without getting caught or damaged. The net is big enough to fit a large truck and trailer inside. It costs $100,000. It has holes in it so most small fish can escape, but the bigger fish are trapped.

The trawler can travel at 10 to 14 knots but it travels at 3 knots (about 5 km per hour) when it is fishing. The fish enter the net and move into the cod end as the net is pulled along. The cod end of the net could have 40 tonnes of fish in it if it is full.



When the net is full or not catching any more fish it is hauled up – first the doors, then the front of the net, and lastly the cod end. It may take nearly an hour to haul up. When the cod end is on the deck it is opened and the fish catch drops onto the fish deck below.

Here the crew sort the catch. The fish have their heads and guts removed by a machine and they are filleted and packaged. They are quickly frozen and stored in the trawler's freezers. Most of the bottom of the trawler is a giant deep freeze. Each catch is weighed and recorded. People do not catch more than they are allowed to so there will be enough fish left for the future.

New Zealanders eat some of the orange roughy but most of it is exported to the United States.

Living on a trawler

A trawler might have a crew of 35 to 40 men and women including the skipper, two officers, two engineers, and a cook. Someone on the trawler has to know first aid in case of an accident. The crew work on the deck with the nets and on the fish deck processing fish.

The crew have to be very strong. It is hard, physical work, and they work for up to twelve hours a day, sometimes in very rough weather, with the trawler constantly moving up and down.

The crew have to be able to get on well and to like being away from home for a long time. They can't get TV on the boats when they are away from the coast, but they do have videos. The trawler needs enough fuel, water and food to last the month, and replacement equipment in case its fishing gear or engine breaks down. It has to carry first aid gear.

7. Bridge of a Trawler

Teachers' notes

Technological Areas: Electronics and Control; Structures and Mechanisms

Context: Business

Achievement Objectives

Technological Knowledge and Understanding:

- explore and discuss the use and operation of technologies in everyday use;
- describe how particular groups of people carry out technological activities.

Technological Capability:

- gather information, and identify and discuss needs, opportunities and preferences in their local environment.

Technology and Society:

- explore and compare the roles of some example of technology in daily life in their own and another place and time.

Technology in the New Zealand Curriculum (Level 2) pp 32, 36 and 42

Questions

- Do you know what this part of a boat is called?
- What happens here?
- What equipment can you recognise?
- How does the skipper or captain know where the trawler is?
- How does the skipper keep in touch with the land or other ships?
- How does the trawler skipper know where to fish?
- Who is in charge of the trawler?

Activities

- Children could find out how an echo sounder is used to find fish to catch, using the student information section 'Bridge of a Trawler' and through their own independent research.
- Children could look at maps and discuss latitude and longitude. The class could learn how to use a compass.
- Children could make a map of an imaginary coast with a port, the fishing grounds marked, and some hazards like rocks, reefs or small islands. Discuss compass points. Children could show where north is on their maps. They could plot the course of a trawler from the port to the fishing ground.
- When they fish within sight of land, fisherpeople can line up points on shore to find their favourite fishing spot. Children could identify places in the playground by lining up objects, for example, 'The place where the flagpole is in line with the ngaio tree and the netball hoop is in line with the power pole.'

- As a class, discuss how skippers found out where they were at sea, what the weather would be like, and where to find fish 100 years ago. Make a comparison chart:

How the skipper:	100 years ago	Now
– knows where the boat is – finds out about the weather – knows where the fish are – communicates with other boats – steers the boat – knows about hazards like small islands		

- Children could make a ship's log. They could write an entry for a fishing trawler as it trawls for orange roughy, including details like the weather and their position at sea.
- Investigate how the Global Positioning System (GPS) works using the students' information page 'Global Positioning System'.

Suggestions for Reporting

Children could:

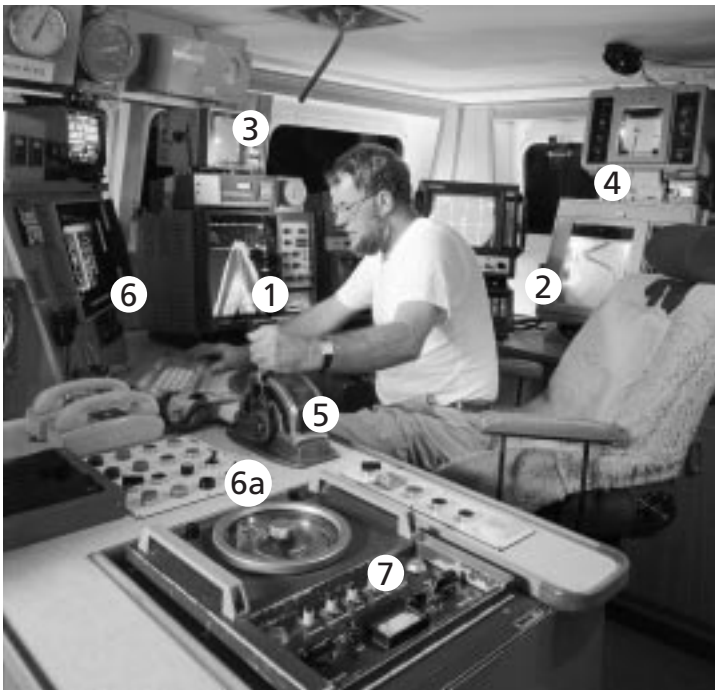
- display the chart about fishing 100 years ago and today
- in pairs or groups, show their maps of an imaginary coast and explain their features to each other
- show one another how a compass is used.

Assessment Suggestion

Teachers could assess children's understanding of different fishing technologies in their discussion of fishing 100 years ago and now.

BRIDGE OF A TRAWLER

1 Echo sounder (video)
2 Echo sounder (paper)
3 Net monitor (video)
4 Net monitor (paper)
5 Engine control
6 Seaplot
6a Seaplot control
7 Autopilot control



The bridge is the place on a trawler where the skipper or person in charge controls the trawler.

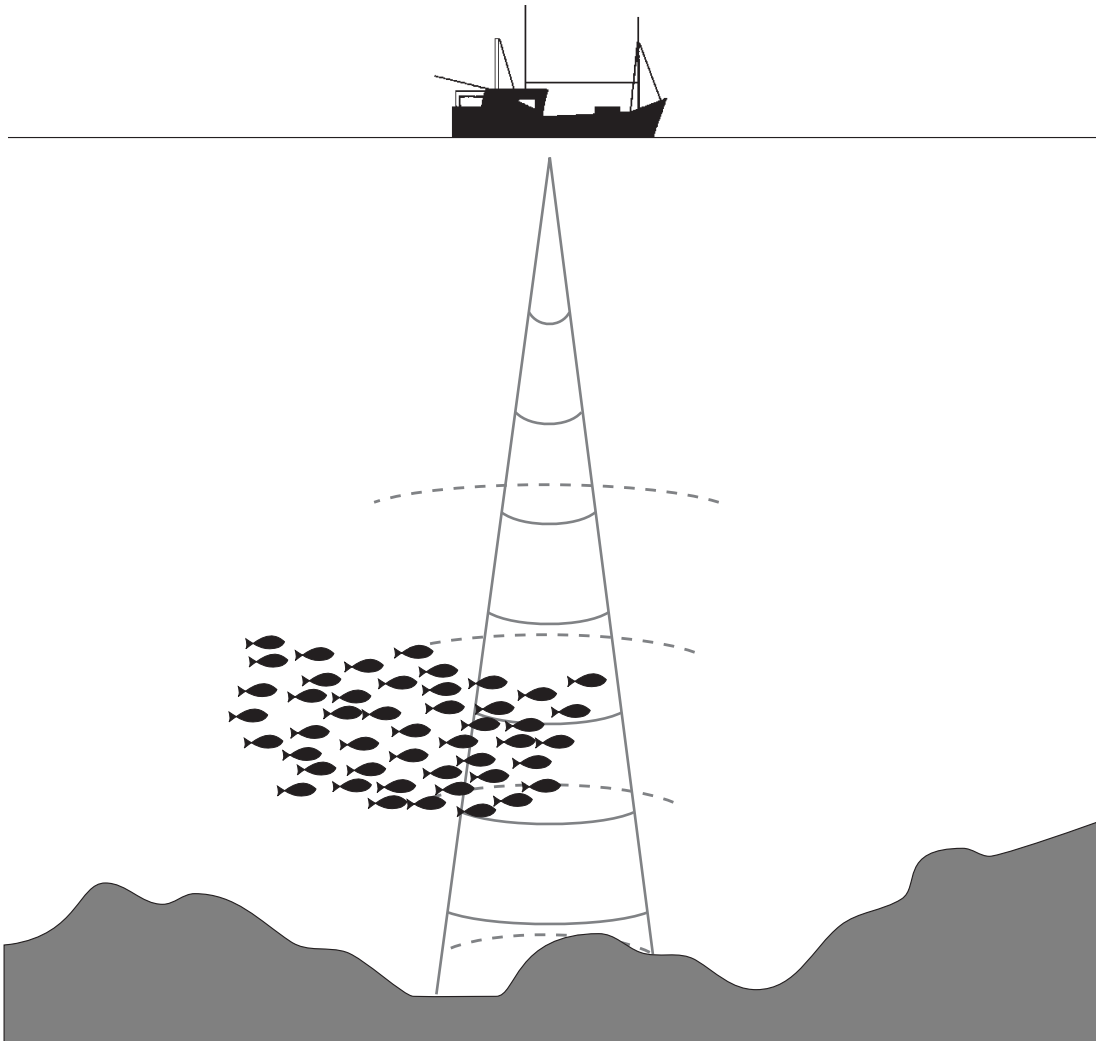
The skipper gathers information from all sorts of equipment and makes decisions about what speed the boat should go, what direction to go in, and whether it should be fishing or not.

The skipper uses big maps called navigation charts. These show how deep the water is and if there is any land or rocks the ship must steer clear of. They also have a map which shows the areas where they are allowed to fish, and maps that show where they have caught large numbes of fish on earlier trips. Trawlers use track plotters. These make electronic charts showing where the fishing grounds are, the depth of the water and past catches in that place.

The trawler receives the latest weather information by radio. The skipper can talk to shore radio or to other ships. On the bridge there is a radar screen which shows where other ships are on the sea.

The ship has a wheel that the skipper or crew can turn to get the ship to change direction, but it is often steered by computer. The skipper and crew can take over from the computer and change direction whenever they want.

Echo sounder



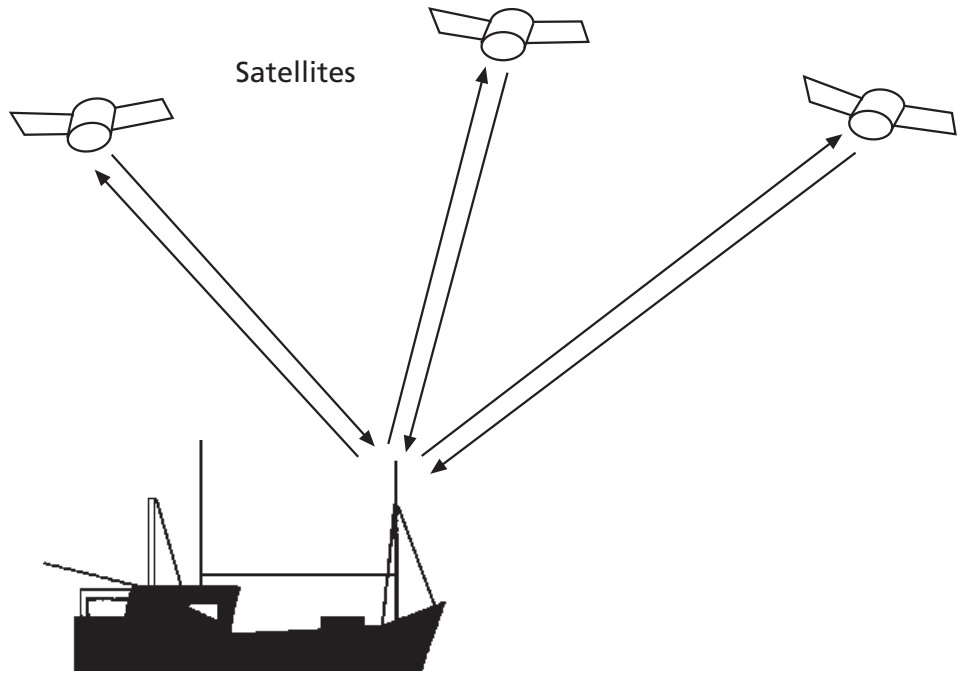
An echo sounder is used to show what is underneath the trawler. Someone who knows how to read signals from echo sounders can identify schools of orange roughy or other fish, and find out about the sea floor.

An echo sounder sends sound waves from the trawler down through the sea. When the sound waves reach solid objects or the sea floor they are bounced back. A sensor on the trawler picks up the returning sound waves and converts them into a colour picture on a computer screen.

The skipper looks at the screen and sets the net to catch schools of fish they have seen on the screen. The echo sounder will show parts of the sea floor that are so rocky they would damage the net.

Another machine on the bridge is a net recorder that gives the skipper information about the net and the amount of fish that are in the net.

GLOBAL POSITIONING SYSTEM



Global Positioning System or GPS is an electronic navigation system using satellites which are circling up above the earth.

There are 21 GPS satellites that orbit the earth every 12 hours. They are 10,000 miles above the earth's surface. Trawlers use this system to find out exactly where they are.

Radio waves are sent from the trawer's aerial to a number of satellites. The radio wave is received by the satellite and bounced back to the trawler.

The GPS computer on the trawler receives back signals from three to eight satellites. The computer uses this information to tell the skipper the exact position of the trawler.

It tells the skipper the latitude and the longitude of the trawler. It shows the position of the trawler on a map on the computer screen.

GPS is used by planes, submarines and in many other situations. It can be used to track sea and land animals and birds fitted with electronic devices.

8. Māori Fishing

Teachers' notes

Achievement Objective

Making Sense of the Nature of Science and its Relationship to Technology:
- investigate the way common items of technology have developed.

Science in the New Zealand Curriculum (Level 2) p 28

Questions

This is how people fished off the coast of New Zealand two hundred years ago.
- What can you see happening here?
- What do you think the canoes are made of?
- What do you think they will do with the fish they catch?
- How do you think the Māori knew where to find the fish?
- How do Māori go fishing these days?

Suggestions for Activities

- Invite a local kaumātua to come and talk about Māori fishing in your area. Ask what fish were caught in your area and if they are still caught today. Find out how the seafood was caught or gathered. How was it cooked in the old days and how is it cooked now?
- Look at a copy of the English version of the Treaty of Waitangi and discuss what it says about Māori fishing. Children could write a report about how Māori fished in New Zealand 150 years ago and how they fish here now. Contact Te Ohu Kai Moana, the Treaty of Waitangi Fisheries Commission at PO Box 3277, Wellington for information about Māori interests in the modern fishing industry.
- Children could use the local library to research traditional Māori fishing equipment. Find out about the different types of waka that were used, what they were made of, how long they were and how many people sailed them. Find out about different types of nets, lines and hooks that were used and the types of fish they caught.
- If you can, go to see a waka. Children could draw pictures of the waka and find out what equipment on board is used for.
- Interview people who have fished in your area over a long time. Ask them about the best time of year to catch fish and seafood. Find out how fishing in your area has changed.
- Make a fish calendar showing the months of the year and the best times to catch and gather fish and seafood using the information provided by a kaumātua or people interviewed. The Māori name for a calendar is a maramataka.

Suggestions for Reporting

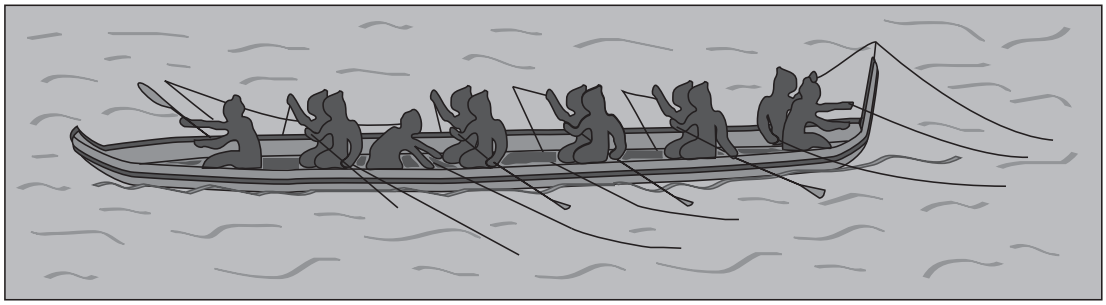
Students could:
- write a story about what it would be like to be a Māori on a large fishing canoe 200 years ago
- present their findings about the modern Māori fishing industry to the class
- make a drawing of a traditional waka and identify the equipment on the waka.

Assessment Suggestion

Teachers could assess the children's understanding of how Māori fishing technology has changed over time.

MĀORI FISHING

A thousand years of fishing



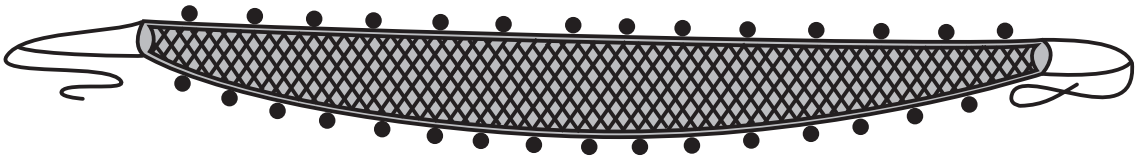
People have been fishing in New Zealand ever since Māori first arrived here over a thousand years ago.

The first people to live in New Zealand sailed here from the Pacific Islands. They came here from hot tropical islands that were quite small. They found lots of strange new things to eat here: birds like ducks and moa, big sea animals like seals, and new plants to eat like ferns and berries.

They brought animals with them on their large waka. They brought rats and dogs and maybe some other animals like pigs and chickens. They brought plants to grow for food such as taro and kumara.

The Māori people really liked fish because that was the food they ate most before they came here. Many Pacific Islands are small and have poor soil which doesn't grow much. The people rely on the food they can gather from the sea.

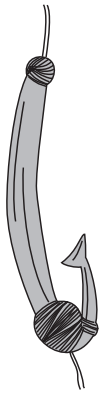
When the first Europeans arrived in New Zealand they noticed that Māori people were often at sea fishing. Some of the canoes they went fishing in were very large – longer than the boat that the explorer Captain Cook had sailed to New Zealand in.



Māori used lines and hooks, nets and traps to catch fish. Captain Cook saw one fishing net that was the same length as 8 rugby fields! The fish that were caught in these huge nets were often dried so they could be eaten later or given to other tribes.

When waka were going a long way out to sea to fish they would carry enough men so that if the weather changed, there would be plenty of people to row the long distance back to shore.

A lot of the nets they used were woven out of flax. To make a large net, a whole village would weave pieces that were then sewn together. Fish hooks were made out of shells, stone, bone or wood. Europeans copied the designs of some of these hooks because they were so good for catching fish.



The Māori tribes didn't have scientists like the scientists who study fish today, but instead they had tohunga. They carefully watched the fish – when they fed, where they swam and what time of the year they laid their eggs (spawned). Tohunga told the people when to fish, where the most fish were to be found, and when it was important to leave the fish so there would be plenty for everyone in the future. They passed this knowledge on to their children.

By the time the Europeans arrived here, the Māori people were experts in how to fish in the waters around New Zealand.

9. Eating Fish

Teachers' notes

Technological Areas: Food; Production and Process

Context: Business

Achievement Objectives

Technological Knowledge and Understanding:

- explore and discuss the use and operation of technologies in everyday use;
- describe how particular groups of people carry out technological activities.

Technological Capability:

- gather information, and identify and discuss needs, opportunities and preferences in their local environment;
- discuss possible solutions and strategies and select and develop a suitable option;
- show and describe examples of their intentions, progress and outcomes to others.

Technology and Society:

- explore and compare the roles of some example of technology in daily life in their own and another time or place.

Technology in the New Zealand Curriculum (Level 2) pp 32, 36 and 42

Questions

- Have you eaten fish and chips?
- Where do you buy your fish and chips?
- Do you like them?
- Do you think fish and chips is a healthy food?
- What other seafood takeaways do you like?
- Where does your family buy fish?
- What is your favourite fish meal?
- How would you choose a good place to buy fish?

Activities

- Share a fish and chip lunch with your class.
- Visit a takeaway shop that sells fish and chips. Have the students brainstorm some questions in advance. Ask about how fish and chips are cooked. Make a list of the steps they go through to make fish and chips. Find out which nights are the shop's busiest nights. Why do they think people come on that night? How many chips and how much fish are used on a busy night? Where does the shop owner get their fish and their chips?
- In pairs, predict the sort of takeaway meal that is the most popular in the class. Prepare and conduct a survey to find out what takeaways members of the class eat and what are their favourites. Discuss how good their predictions were.

- Children could discuss their favourite fish meal. They could identify a possible new fish takeaway. They could decide on a process for preparing and presenting their new product and develop packaging for it. What sorts of packages appeal to children of their age? Why? What practical considerations are there for the materials chosen and the design, for example, materials which keep food hot and don't disintegrate. They could develop a process to market the product to families with children of their age.
- Children could interview people in their community about how fish takeaways have changed over time. They could compare fish and chips wrapped in newspaper with other takeaway fish products. Why are fish and chips popular?
- Visit a fish shop or supermarket to see what fish products are available. Children could find out what sorts of fish and seafood people buy most often. Work out how much it would cost to have fish for dinner for four people. Work this out for three different types of fish or seafood. At the fresh fish counter watch the shop assistant weigh the fish and work out what it costs. How do they keep the fish and seafood fresh and good to eat and how do you recognise fresh fish and seafood?

Suggestions for Reporting

Children could:

- make a flow chart showing the steps taken to prepare and cook fish and chips
- display the packaging and the marketing plan for their new fish takeaway
- display the results of the class survey on takeaways as a graph.

Assessment Suggestion

Teachers could assess the children's understanding of the process of cooking fish and chips as displayed in their flow charts.

Background Information

The fish used in fish and chips varies depending on the season and what fish is being caught. It may be hoki, red cod, terakihi, warehou, rig or lemon fish.

People who sell fresh fish will know all about the fish and seafood they sell, and can answer questions customers have about the types of fish and methods of cooking the fish.

EATING FISH

Fish is a very healthy food. It has a lot of protein and not much fat. Fish contains many of the vitamins and minerals that we need to eat to make us healthy.

Fish shops and supermarkets sell many types of fish. They sell whole fish, fish fillets, fish heads and bones, and fish roe (eggs). They also sell other seafood like mussels, oysters, whitebait, squid and rock lobster that have been caught in New Zealand. Sometimes they sell seafood like frozen shrimps and prawns that were caught overseas. Fish can also be canned, frozen, vacuum-packed or processed in other ways.

Fish and chips is the most popular takeaway meal in New Zealand: 56% of all New Zealanders over the age of ten eat fish and chips at least once a month. However, because fish and chips are cooked in fat or oil it would not be healthy to eat fish and chips every day.

People who work in shops selling fish handle it carefully so it remains fresh and safe to eat by

- washing their hands and wearing gloves or using tongs when they touch the fish
- keeping long hair tied back away from their faces

- keeping the fish covered in the fridges, or keeping it on the top shelf so nothing drips on it
- keeping the shop counters, benches and equipment like knives and boards clean
- using chillers or ice to keep fish fresh while it is on display.






10. Processing and Packaging

Teachers' notes

Technological Areas: Food; Information and Communication; Production and Process

Context: Business

Achievement Objectives

Technological Knowledge and Understanding:

- identify and compare the ways particular technological developments are communicated and promoted to specific groups, such as information on packaging.

Technological Capability:

- gather and collate information on needs and opportunities in the local environment.

Technology and Society:

- identify and consider different views and feelings of people in relation to some specific technological developments or effects.

Technology in the New Zealand Curriculum (Level 3) pp 32, 37 and 42

Questions

- What do you think is happening here?
- Which types of seafood have you eaten?
- Why is seafood processed and packaged like this and not just sold fresh?
- Why do people buy seafood that has been processed and packaged?

Activities

- Visit a supermarket or a grocery store to find out all the different ways fish and seafood are sold. Discuss the advantages and disadvantages of each type of packaging.
- Bring in labels from packages of fish and seafood and display them. Discuss what sorts of things you see on the packaging, for example, product information, ingredients, an attractive picture, the name of the country it came from, some product promotion, the use by date. Why is this information important? Which packaging do they think would be most likely to persuade people to buy the product? Why?
- Design a label for a container of fish or seafood – choose how it is packaged, which country it is to be sold to, and what sort of information should be on the label.
- Visit a fish factory. Have students develop questions about how they process fish and seafood in the factory. Find out how the fish is packaged and what language is on the labelling and packaging. How do they make sure the fish and seafood products are safe to eat? Who buys the fish and seafood they sell?
- Invite someone from the local community who smokes fish to talk to the class about how it is done.

- In class, taste some fish and seafood that has been processed in different ways. Discuss if there were any foods which they hadn't tried before and which ones they liked. In groups, children could design a leaflet to advertise seafood to other children in the school. How will they persuade children to try different sorts of seafood?

Suggestions for Reporting

Children could:

- make a class chart showing the different ways of selling fish and seafood which they have found. Students could stick wrappers or packages onto the chart.
- display the leaflets they have designed to sell seafood
- draw a flow chart showing the steps involved in processing fish at a fish factory.

Assessment Suggestion

Teachers could assess the children's understanding of the types of information which needs to be on the seafood label.

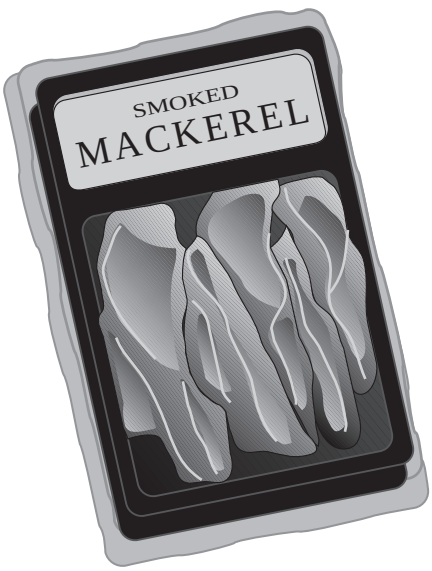
PROCESSING AND PACKAGING

Eating fish and seafood

People from many countries preserve fish and seafood. In the past, they covered it in salt or smoked it or dried it. Māori have preserved fish and seafood for over a thousand years here.

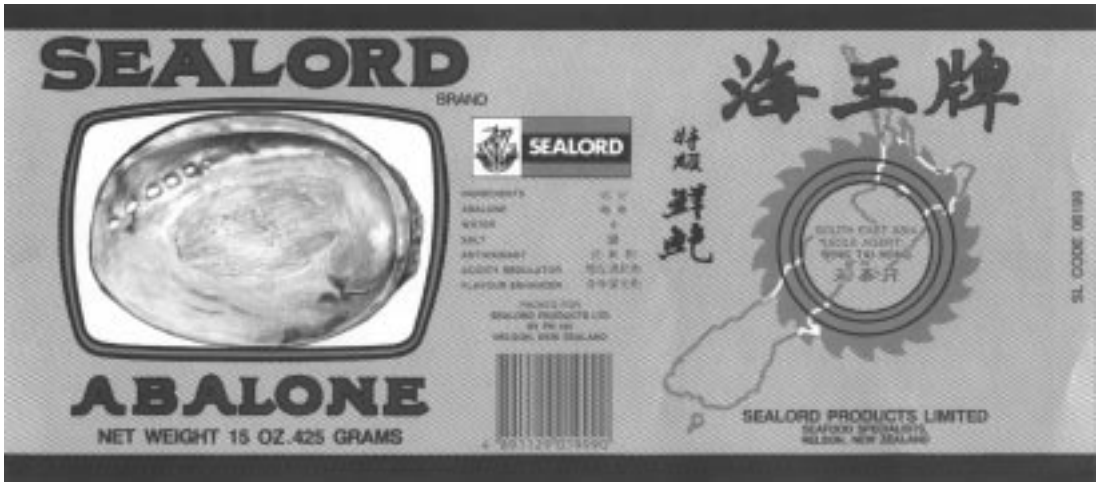
Nowadays, some of the seafood gathered by commercial fishers is sold fresh. But most of it is taken to factories where it is processed.

Fish and seafood can be bought in cans, cardboard boxes, plastic pottles and vacuum sealed packets. Some ways of processing and packaging keep seafood fresh for years. Fish may be raw or cooked before it is packaged. It is often frozen to preserve it.



Selling Our Seafood Overseas

90% of our fish and seafood products are exported (sold overseas). New Zealand earned 1.2 billion dollars ($1,200,000,000) from the fish and seafood we exported in 1995.



The main countries we export to are:

Country	Percentage by value of our fish and seafood exported in 1995
Japan	30.2%
USA	26.4%
Australia	10.7%
European Union	10.2%

The fish and seafood which earned the most money overseas in 1995 were:

squid	NZ$159 million
orange roughy	NZ$155 million
hoki	NZ$148 million
rock lobster	NZ$114 million
greenshell mussels	NZ$ 86.7 million
ling	NZ$55 million
snapper	NZ$ 50 million
pāua	NZ$ 35.5 million

Fish which is exported should reach other countries in excellent condition so it tastes great and people will want to buy more of it.

11. Conservation

Teachers' notes

Achievement Objective

Making Sense of the Nature of Science and its Relationship to Technology:

- investigate the impact of some well known technological innovation or scientific discovery on people and/or the local environment.

Science in the New Zealand Curriculum (Level 3) p 30

Questions

- What do you think is happening in this picture?
- Why do people need to know about fish and what do they need to know?
- What information do you think scientists would gather about fish?
- Fish live in the sea, so how do people find out how fish live?

Activities

- Invite a scientist, or someone who studies animals, to come to talk to the class about finding out about animals. As a class, decide on questions. How do scientists get information about the animals they study? How do people find out about where fish live, what they eat, their habits, and their life cycle? Discuss why scientists and other people need this information.
- Visit a place where sea animals are studied like a hatchery or marine laboratory and find out what the scientists do.
- Have a lolly scramble. Include some popular lollies and some less popular lollies. Discuss how it felt if you got lots of lollies and how it felt if you got none. Were there lollies that everybody wanted and lollies that no-one wanted? This situation can be compared to fishing in New Zealand before the Quota Management System. All commercial fishers competed against each other to catch the available fish. Some fishers were more successful than others. If children allocate their lollies like the Quota Management System everyone would be able to buy a share of each type of lolly. If you had a 50 percent share in the jellybeans, you would get 50 percent or half of all the available jellybeans. Children could sell or trade their quota. They could trade some or all of their 50 percent share of jellybeans for some or all of someone else's 30 percent share of liquorice allsorts if they liked those better. They could sell their 50 percent share of jellybeans to someone who wanted them and not have any lollies at all.
- Design a game that shows the dangers to a young fish as it is growing up including how people help or reduce its chances of surviving to be an adult fish.
- Children could role play two people fishing on a day when the fish are biting and they are catching lots of fish. One person wants to take all the fish and the other is explaining why they shouldn't.
- Children could find out how other countries protect their fisheries and prevent them being over-fished.

Suggestions for Reporting

Children could:

- write a report on the quota system for fishing using the analogy of a lolly scramble
- explain their game of a young fish's survival and play it
- have a class discussion about the scientist's visit and summarise what the children learnt about working with animals.

Assessment Suggestion

Teachers could assess the children's understanding of people's role in helping young fish survive in the sea as shown in their games.

Background Information

Prior to 1983 there were no individual limits on the quantities of most commercial fish species that could be caught, although the total catch level was controlled. Commercial fishers competed for the available fish. This intensive fishing significantly reduced the numbers of some fish species in certain areas.

In 1983 New Zealand introduced a Quota Management System for deep water fish species to ensure the management and conservation of our fisheries. This was expanded to most inshore and other species in 1986.

Each year scientists and the industry carry out research to estimate as accurately as possible the populations of our major fisheries. The Government reviews these figures and the Minister of Fisheries sets an annual Total Allowable Commercial Catch (TACC) for each species that allows for fish to be sustainably harvested.

Fishing companies and fisherpeople hold quota. Quota can be bought, sold or rented. A company or person who owns quota for a commercial fishery owns a percentage of the fishery. If they have quota for 10 percent of the fishery, they can take 10 percent by weight of the TACC.

This Quota Management System will allow all our fisheries to be managed so they are not overfished and they remain an important resource for the future.

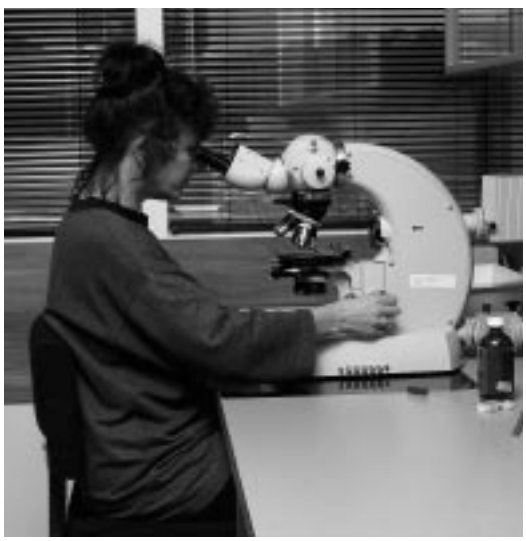
CONSERVATION

Keeping fish for the future

In New Zealand we need to catch fish to eat and to sell overseas, but we need to make sure that there will be enough fish for people to catch, sell and enjoy in the future.

Before 1986 commercial fishers competed with each other to catch the available fish. It was possible for commercial fishers to take too many fish from one area.

Since 1986 we have had a Quota Management System. The Government decides how many of each type of fish are allowed to be caught each year. Scientists gather information about the numbers of types of fish we catch commercially. This information is used by the Government to decide how many of each type of fish are allowed to be caught each year.



Commercial fishing companies and commercial fishers buy a quota or share of the amount of fish that can be caught. If a fishing company buys a 10 percent share of the orange roughy fishery in a particular area, for example, the south east coast of the South Island, they are allowed to catch 10 percent of all the orange roughy that can be caught there that year.

This is Dianne Tracey. She is a scientist who studies fish. She spends about three months a year on the *Tangaroa*, a fishing research boat owned by NIWA.

"We have to work out the numbers of orange roughy there are in the sea so that the Government can decide on a safe number that can be caught each year and leave enough fish for the future," she says.

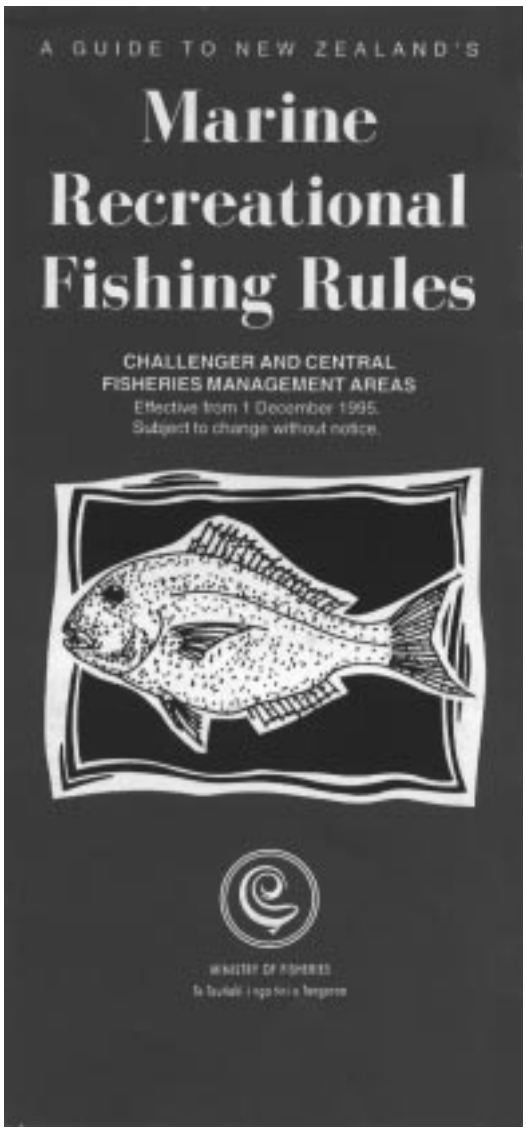
"We use nets to get samples of the fish in different parts of the fishing ground. We count the numbers of fish and use computer programs to make estimates of the number of fish in the ground.

"We measure the length and weight of orange roughy and find out their sex. We find how old an orange roughy is by taking out a bone in its ear called the otolith. We count the rings on the otolith and that tells us how old it is. All this information helps us to know how to manage the fishery."

People who fish for food or fun must conserve fish. There are limits on the number of fish and shellfish people can take in one day. These limits are set on most of the fish and shellfish we eat. You are breaking the law if you take more fish or shellfish than you are allowed, and you could be prosecuted and fined.

People should carefully return undersize or small fish to the sea so they have a chance to grow and reproduce.

There are pamphlets which explain these limits that you can get from sports shops, diving shops, fishing clubs and the Ministry of Fisheries. Look at the pamphlet for your area and find out about the numbers and size of fish and shellfish you can collect in one day.



12. Mussel Farming

Teachers' notes

Achievement Objectives

Making Sense of the Nature of Science and its Relationship to Technology:

- Investigate the impact of some well known technological innovation or scientific discovery on people and/or the local environment.

Science in the New Zealand Curriculum (Level 3) p 30

Questions

- Where can you find mussels?
- What do mussels eat?
- How do you collect mussels?
- How do you eat mussels?
- What do you think happens on a mussel farm?
- Why do people farm mussels?
- Can anyone collect mussels from a mussel farm?
- Does the farmer own the water the mussels grow in?
- What happens to the mussels grown on the mussel farm?

Activities

- Obtain a mussel from the beach or from a supermarket. Children could investigate how the two shells hinge together. Draw the outside of the mussel. Look inside. How does the mussel hold on to the inside of its shell?
- If you live near a rocky shore with mussels visit the beach. Find out where you can find the mussels at high tide and low tide. Find out how big they can grow. Investigate how mussels hang onto rocks. Discuss how they survive without water at low tide.
- If your school is on the internet you could establish a link with schools that are in mussel farming areas. Children could prepare questions to find out about mussel farming and exchange information. There are some good sites on the world wide web about fish and seafood and children could explore these.
- Children could make a chart comparing mussel farming with farming sheep or cows. Consider where they live, food, space, keeping healthy, and harvesting.
- Eat fresh, marinated or cooked mussels.

Suggestions for Reporting

Children could:

- draw the section of beach they visited and show where the mussels are found
- display their drawings of mussel shells
- display their chart about mussel farming.

Assessment Suggestion

Teachers could assess the children's understanding of the technology used by people to farm mussels in the sea.

MUSSEL FARMING

All about mussels

In New Zealand we have two types of mussels, the greenshell mussel and the blue mussel. Mussels are found on rocky shores around New Zealand. You can often see them growing and can collect them at low tide.

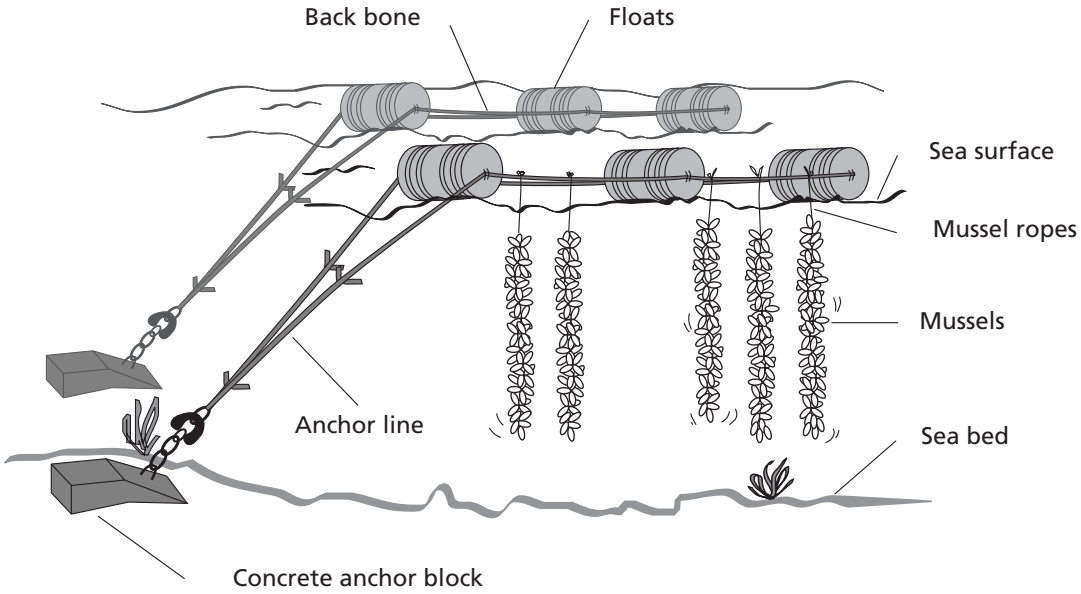
Mussels hang onto rocks or ropes using threads called byssus, and grow a hard shell to protect themselves. When a living mussel is under water the shell stays slightly open so the mussel can feed. They eat by sucking lots of water into their shells. They take small plants and animals (algae and plankton) from the water and then push out the water. They take the oxygen they need to live out of the water.

Mussels are eaten by seabirds, fish, octopuses and people. There is a limit on the number of mussels people are allowed to gather in one day.

Farming mussels

Mussel farmers grow mussels and sell them to make money. Areas of New Zealand like the Marlborough Sounds, the Coromandel Peninisula and Stewart Island are good places for mussel farms because they have areas of sheltered water that is not polluted and has lots of food for the mussels.

The mussel farmers gather spat or very young mussels from the sea and make them attach to ropes by covering them with a net stocking. This stocking rots and leaves the mussels growing attached to the ropes. Mussel farmers look after the mussels on their farm until they are big enough to eat. Then they harvest them by taking the adult mussels off the ropes. New ropes are hung and more spat is gathered and attached to the ropes.



At certain times of the year fish like snapper come into the mussel farm area to eat the young mussels.

Only certain areas of sea are able to be used for mussel farms. Mussel farmers must have a licence to farm mussels in that area. They do not own the sea that that their farm is in, but they own the floats and ropes and the boats they use to collect the mussels, and the mussels that grow on their farms. No-one else is allowed to collect these mussels.

Sometimes very large numbers of certain algae grow in the water. Mussels and other shellfish eat this algae. The algae does not affect the mussels or shellfish but if people or other animals eat shellfish containing the algae they can get sick.

Mussels and shellfish are tested all year round to make sure they are safe to eat. If shellfish are found to contain algae that could make people sick the mussel farms will stop harvesting mussels. People will be told not to take mussels from the rocks until the algae numbers have gone down and the mussels are safe to eat again.

Mussels are taken to the mussel factory to be processed and packaged. Mussels that will be exported are steamed and then frozen as mussels in half shells or as mussel meat. In New Zealand, most mussels are sold either as live mussels or as marinated mussels. Marinated mussels are steamed and removed from the shell, then put into pottles with the marinade and refrigerated.

MUSSEL LIFE CYCLE

A female mussel can produce eggs at one year old. Females produce 100 million eggs in a season and release them into the water. They are fertilised in the seawater by sperm from male mussels.

The eggs are 0.5 mm in diameter. They change into veliger larvae within 48 hours. Veliger larvae are small free swimming larvae which swim in the sea for 3 to 5 weeks, before they come back to sheltered waters.

The larvae settle onto ropes or seaweed and change into spat or young mussels.

The young mussels grow quickly into adult mussels.

Resources

School Journals

The *School Journals* have many useful stories and articles on fish and fishing. Consult the *School Journal Catalogue*. Check the *Learning Media Catalogue* for other useful Learning Media resources.

Books

There are a number of useful general guides to New Zealand fish species – these would be useful for teachers and students. Some of these are:

- ***Collins Guide to the Sea Fishes of New Zealand*** by T Ayling & G J Cox. Auckland: Collins, 1982. 343 pp. Detailed guide to all New Zealand fishes.
- ***Guide to New Zealand Commercial Fish Species*** from the New Zealand Fishing Industry Board. Wellington 1990. 216 pp. Nonscientific guidebook to New Zealand's commercial fish species highlighting flesh characteristics and equivalent foreign names.
- ***The Handbook of Marine Fishes*** by L H Paul, J Moreland & E Heath. Auckland: Reed Publishing Ltd, 1993. 150 pp.

A useful fish biology book is:

- ***Fish – Eyewitness Books*** by S Parker. London: Dorling Kindersley Ltd 1990. 63 pp. Excellent general introduction to fish biology, good photographs.

A useful book about Māori life in New Zealand before the coming of Pākehā is:

- ***The Prehistory of New Zealand*** by J Davidson. Auckland: Longman Paul Ltd, 1987. 270 pp.

New Zealand Geographic contains two useful articles:

- Deep Water Fishing – No. 4, 1989
- Greenshell Mussels – No. 18, 1993.

Other School Resource Kits

- ***The Underwater World – Te Marae Nui o Hine-Moana***. Available from the Department of Conservation, Box 10-420, Wellington – $10. Includes dolphins, marine reserves, fishing, starfish, seaweed forests, crayfish and marine habitats – poster, worksheets and pamplets included.
- ***The Treasure Chest.*** A 'hands on' activity-based kit about the seashore containing posters, books, videos, marine samples and special interactive material. Available on loan from: The Resource Centre, Dunedin College of Education, Union Street East, Dunedin, phone 03 479 3791, fax 03 477 5289.

Information Packs:

- ***Marine Reserve at Leigh***. Available from Friends of Leigh Laboratory, Box 349, Warkworth. Information on the marine life at the marine reserve at Leigh.
- The Marine Education Society of Australasia, MESA New Zealand, Private Bag 3072, Hamilton have produced a number of publications for schools, including: *Fish for the Future: A Resource Booklet for Schools* – $4; a video *There's More to Fish than Tomato Sauce*; and a series of study booklets, including a *Seashore Study* booklet – $3.50; a *Gone Fishing* booklet – $3; *Aquarium Art* booklet – $3; and *Between the Tides Guide* – $20. These resources can also be obtained from the Department of Marine Science, University of Otago, PO Box 8, Portobello, Dunedin, Phone 03 478 1826, fax 03 478 1825.

Videos

- ***Tale of the Crayfish.*** (25 min). Shows the life of a crayfish by day and by night. Available on loan from National Library School Libraries 2000 centres. It can also be borrowed from the Department of Conservation. It can be purchased for $110 plus GST from TVNZ.
- ***The Magic of Paua.*** Life cycle, harvesting and processing for market. Also includes artificial rearing and jewellery. Available on loan from National Library School Libraries 2000 centres. It can be purchased for $75 plus GST from C Thomas, NIWA, PO Box 14-901, Kilbirnie, Wellington, phone 04 386 0300 fax 04 386 1574.

- ***Orange Roughy.*** (30 min). Fishery, research by catch species and processing. Available on loan from National Library School Libraries 2000 centres. It can be purchased for $75 plus GST from C Thomas, NIWA, PO Box 14901, Kilbirnie, Wellington, phone 04 386 0300 fax 04 386 1574.
- The Country Calendar programme ***Orange Roughy*** is available from National Library School Libraries 2000 centres but this programme is less suitable for this age group.
- ***Fish,*** a Country Calendar programme that looks at life on board one of New Zealand's newest deep sea trawlers the *Amatal Colombia* is available for loan from National Library School Libraries 2000 centres. It can be purchased for $110 plus GST from TVNZ.

Posters

Available from *New Zealand Geographic*, PO Box 8900, Symonds Street, Auckland, New Zealand:

- ***Creatures of the Deep Ocean*** $6.50
- ***The Secret World of a Rock Pool*** $6.50

Available from New Zealand Fishing Industry Board, Private Bag, Manners Street PO, Wellington, New Zealand:

- ***NZ Commercial Fish Species*** $6.50 ($12 laminated). One copy provided with this resource.

Sources of Information

- Ministry of Fisheries, Information Unit, Box 2526, Wellington for information on fisheries management and research, and regulations on fish catch numbers and sizes.
- National Institute of Water and Atmospheric Research Ltd, Private Bag 92830, Penrose, Auckland for oceanographic research around New Zealand. Free journal available.
- Sports stores for information on regulations for fish catch numbers and sizes.
- Portobello Marine Laboratory, Department of Marine Science, University of Otago, PO Box 8, Portobello, Dunedin for marine science research, marine education programmes.
- Wellington Marine Laboratory, Victoria University, 396-402 The Esplanade, Wellington for marine science research.
- Leigh Marine Laboratory, University of Auckland, PO Box 349, Warkworth for marine science research.
- Aquariums in your area.

The Water Safety Council, PO Box 10126, Wellington, phone 04 801 9600, fax 04 801 9599 has resource kits available on hypothermia and a Junior Resource Kit, as well as booklets *Waterwise* and *Safe Boating – An Essential Guide*.

CD-ROMS

- ***Microsoft Oceans***. There is also useful information on fish and fishing on ***Microsoft Encarta***.

The Internet

There is a growing number of sites on the world wide web on fishing and fish.

The Museum of New Zealand Te Papa Tongarewa will be providing an online resource for Sea Keepers for Schools on 'Sea Weed'. This site will be available from April 1997.