STUDENT EXERCISES

MARINE ENVIRONMENT

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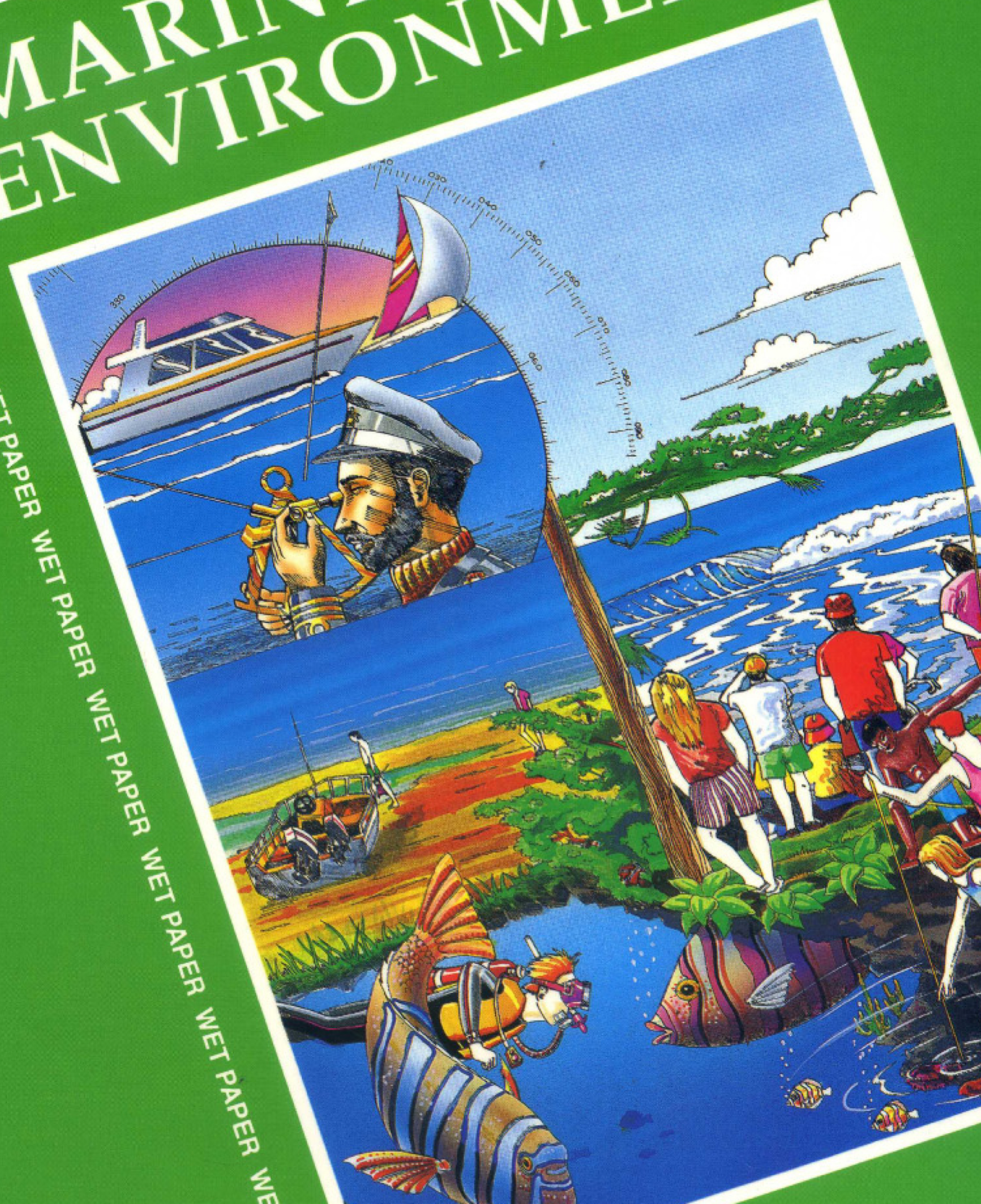

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Dedicated to all schools who bought class sets of our textbook *Marine Studies* and *Mariners Skills* student manual without whose support the financing of this publication would not have been possible

Disclaimer

Although all care has been taken to provide safety instructions, and offers of training and advice, Wet Paper or any of its employees, advisors or consultants accept no responsibility for any accident that may occur as a result of students performing any of these activities.

If schools are unsure of any method, they are advised first to consult with their own State regulations and then if further assistance is required, contact us here at Wet Paper at the above address.

Marine Environment Student Exercises

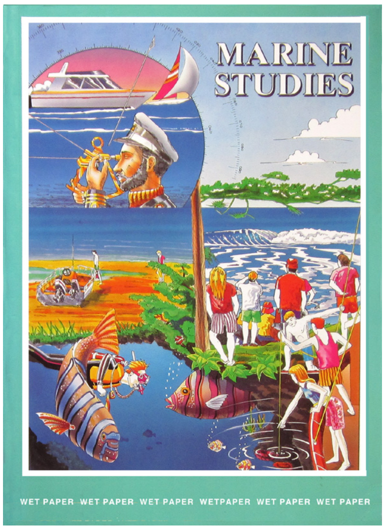
Suitable for syllabus in

Marine Studies and Marine Education (Queensland)
Marine Studies (New South Wales)
Maritime Studies (South Australia)
Environmental Education (Victoria and Northern Territory)
Senior Science Marine Studies and Nautical Studies (Western Australia)

and
companion to the textbook

Marine Studies

A course for senior students



by

Bob Moffatt

B Sc, Dip Ed, Grad Dip.Ed Admin, MACE

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2. For schools who use class sets of the book, an in-service program is available for staff wishing to implement any of the activities. A program can be arranged by contacting the manager.

   Wet Paper also has a commitment to actively support teacher associations and conservation groups with an interest in marine studies education.

3. Schools or teachers can write for our complimentary newsletter which outlines conference dates and other seminars where free workshop sessions are held explaining any activities in this book.

4. Equipment used in this book is available for training purposes at our Wet Paper Laboratory and Classroom during office hours. Our address is 14 Milbong Terrace, Ashmore, Queensland, 4214.

5. If we cannot answer your questions, Wet Paper has a team of highly qualified consultants who are willing to assist.

6. As this is the first edition, we welcome comments on any of the activities. In time, workbooks will be written to indicate the time each activity takes, its sequence and core questions relevant to national syllabus. As many exercises could take more than two hours, some selection of questions may be necessary before setting students homework.

Best Environmental Practice

Each school should develop a best environmental practice statement for marine studies. To help schools do this, Exercise 141 has been prepared as a 'discussion starter'.

In Sections 1 and 2 it is a requirement of some activities to collect specimens of sand, live animals or plants or travel on an excursion into the marine environment.

It is pointless teaching conservation in Section 4 if practical aspects of it are not demonstrated. The following points are worth considering in your school's conservation code:

1. Can a photograph substitute for the collection of a live specimen?

2. Is all waste collected and taken back to school? Encourage students not to use rubbish bins at the seaside as these are often tipped over or scrounged through by animals looking for a feed.

3. Take home bottles and cans that can be recycled at school and if chemicals are used, bring home all waste in slop bottles.

4. Wet Paper encourages students to study live specimens so that a deep love can be generated for life on earth. However the following considerations are recommended:

   - Avoid collecting yourself until trained. Consider buying from a collector who has a permit and is restricted to numbers and can be managed. Most collectors are skilled in the handling of live animals and know about stress and mortality rates. Use an aquarium shop to obtain specimens and find out what conditions would give the specimens the greatest chance of survival.
   - Use hardy freshwater species to illustrate marine examples. Many principles of life in water are the same in both fresh and marine environments.
   - In the activities selected, it is hoped we have chosen the toughest of animals and plants.
   - The aim of students working with live animals and plants is to instil a love of the animals and plants of the sea. Consider buying fish and prawns from a fish shop and avoid any other dissections unless you are specifically researching that animal.

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Cover

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Contents

Section 1 Non – living aspects of the sea

Section 2 Living aspects of the sea

Section 3 Commercial uses

Management and conservation

SECTION 1

NON - LIVING ASPECTS

EXERCISE 1 SEA WATER SALTS

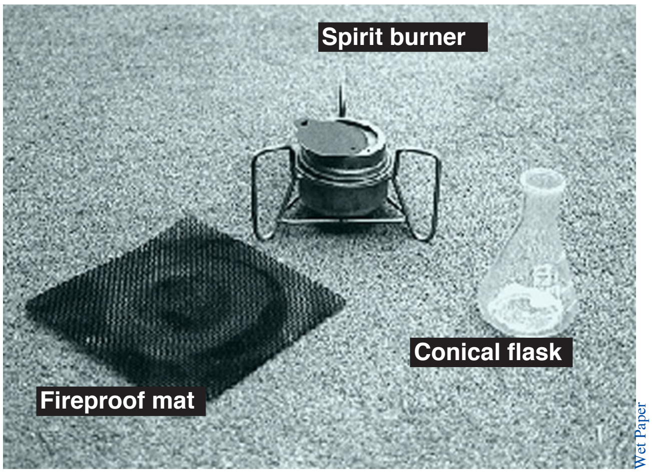


Figure 2.1 Experimental equipment

METHOD

1. Measure out half a teaspoon of salt and empty it into the conical flask.
2. Now add enough water to cover and dissolve the salt.
3. Set up the equipment as shown in Figure 1.1. Now light the spirit burner by using the manufacturers instructions and adjust the burner to produce a gentle flame under the flask.
4. Put on the safety goggles and keep them on until all the salt has evaporated (see safety warning).
5. When the water has nearly all evaporated, extinguish the burner and let the flask cool.
6. Take the stirring rod and scrape the salt out and onto a piece of filter paper.

QUESTIONS

1. Describe what happens to the water as it heats up.
2. What happens when salt water evaporates?
3. What happened when almost all the water was gone?
4. Did you get the same amount of salt back?
5. Use your textbook page 352 to define the following terms:

   a. Solute.

   b. Solvent.

   c. Solution.

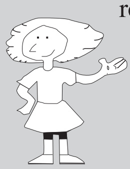
Research

1. Find out how salt is made commercially.
2. http://seawifs.gsfc.nasa.gov/ocean_planet.html

MATERIALS AND EQUIPMENT (PER GROUP)

- methylated spirits burner
- safety goggles
- table salt
- fireproof mat, matches, oven mitts
- very clean 50 mL conical flask and glass stirring rod
- filter paper
- tap water
- tea spoon

SAFETY WARNING



1. When the sea water solution has nearly all evaporated, it may "spit" up. To stop this remove the flame and let the remainder evaproate under its own heat.
2. All equipment will get very hot after a short time, so make sure you let it cool before touching it.

Exercise 2
Salinity

Method

1. Divide up the class into six groups so that each group will work on a different gm/Litre saltwater solutions.
2. Collect 20 drops of your gm/Litre saltwater solution and add this carefully to the 50 mL conical flask.
3. Now add 3 drops of potassium dichromate indicator so as to just turn the sea water yellow as shown in Figure 2.1.
4. Add the silver nitrate drop by drop giving the conical flask a swirl after each drop as shown in Figure 2.2. Make sure someone counts each drop.
5. You will notice that a colour change appears under the drop as it falls into the sea water solution.

   When these dark red patches hang around for an increasingly longer time, start swirling after each drop.
6. When one drop turns all the sea water a reddish brown, you have reached what we call the end point.
7. Record the number of drops to end point in data table 1, in Figure 2.4 beside the g/L entry.
8. Now collect the results from the other groups noting the number of drops to end point for each.
9. Use your class results from data table 1 to draw a calibration graph in the space provided in Figure 2.5 for the determination of salinity using the eye dropper technique. Your graph should look something like Figure 2.3. Extrapolate the graph to predict 35 000 and 40 000 mg/L.
10. Now use an unknown sample to determine its salinity and record your results in table 2 Figure 2.4.

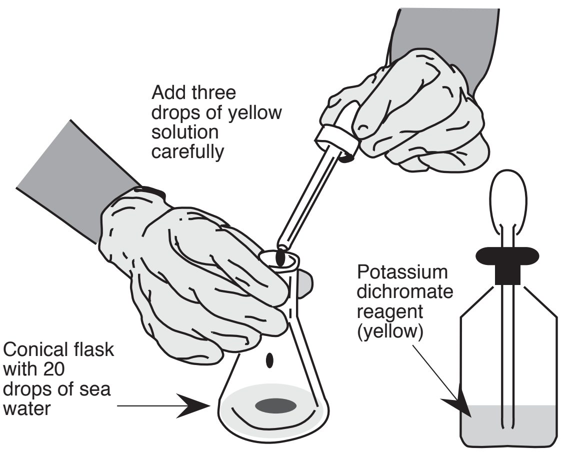


Figure 2.1 Use gloves to add the drops
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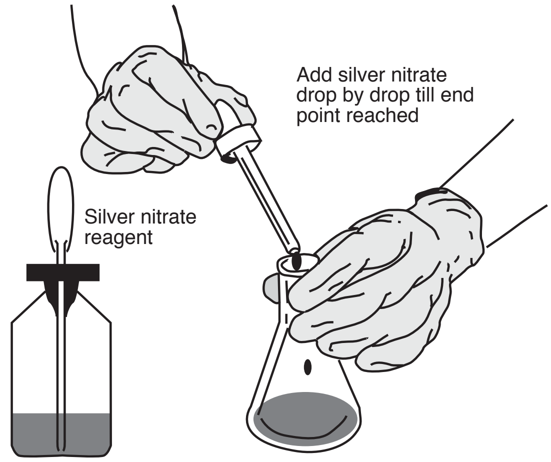

Figure 2.2 Adding silver nitrate solution
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Materials and equipment (per group)

Note keep the 10, 20, 30 g/L solutions for the next exercise.

Equipment required

- 10 mLs of six saltwater standard solutions

  5, 10, 15, 20, 25, 30, grams per litre
- 10 mLs of 0.5M Silver Nitrate solution
- salt water samples (various locations)
- potassium dichromate indicator solution
- 50 mL conical flask
- gloves
- two eye droppers — one marked salt, the other $AgNO_3$

Notes

1. Because eye droppers vary from manufacturer to manufacturer, you will need to keep the same sized eye droppers for future tests.
2. The eye dropper needs to deliver about .1mL.
3. Potassium dichromate is poisonous (see safety warning below).

Safety warning

1. Potassium dichromate is a health risk and should be used carefully and in drops only from a well marked bottle.
2. Silver nitrate is hazardous and causes staining of the hands.
3. **Gloves must be worn during this experiment.**

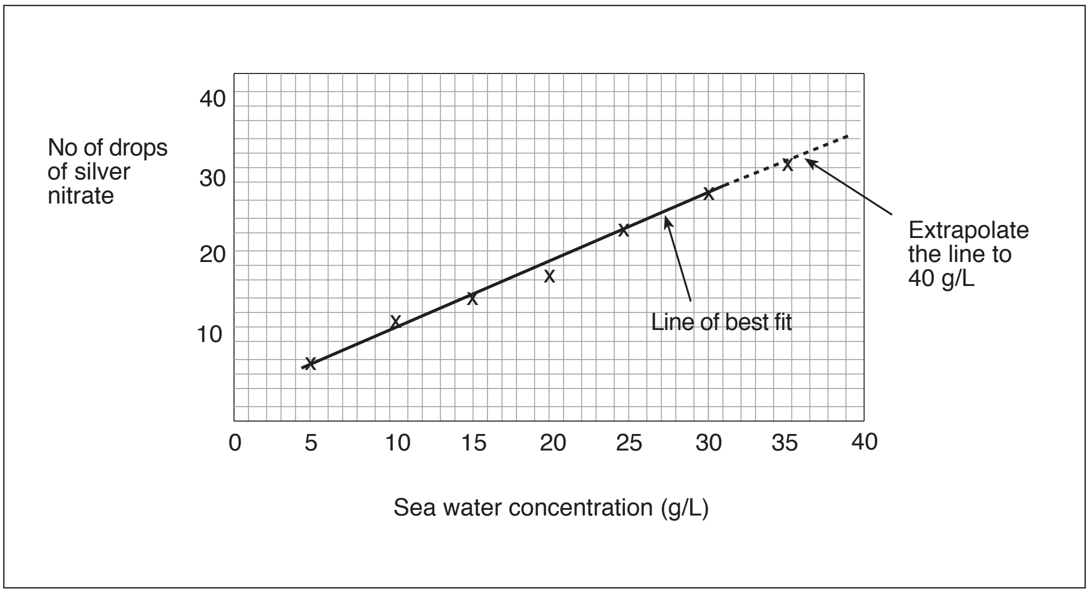

Figure 2.3 Sample calibration graph and safety warning

Data table 1

Standard solution	Number of drops of silver nitrate to end point
5 g/L	
10 g/L	
15 g/L	
20 g/L	
25 g/L	
30 /L	

Data table 2

Sample site (e.g. boat harbour near ramp)	Number of drops of silver nitrate to end point	Salinity in mg/L

Figure 2.4 Results

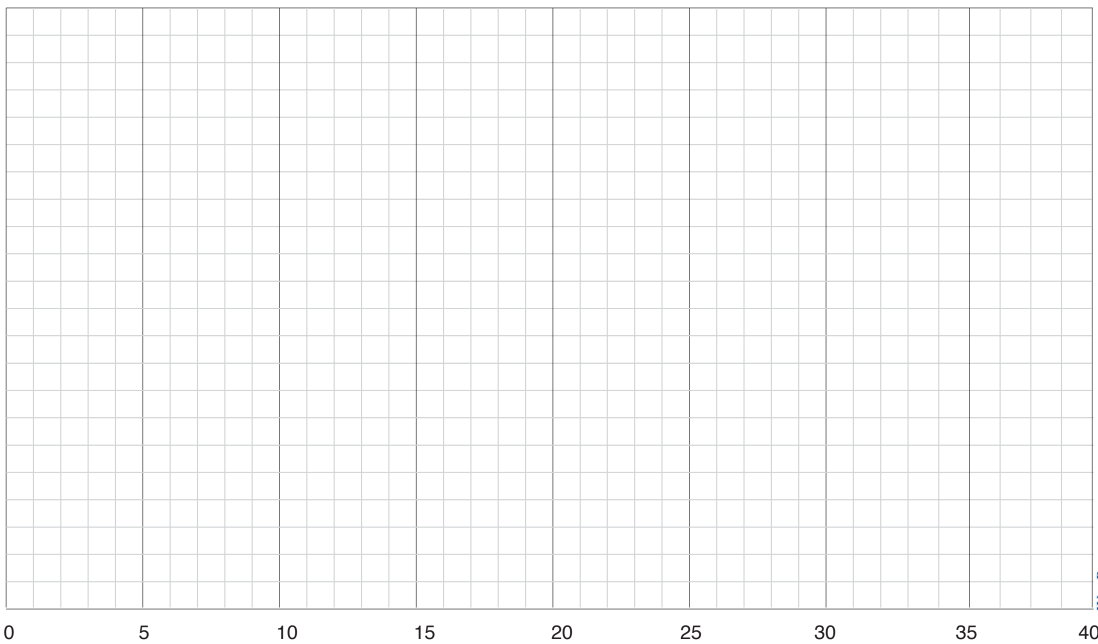

Figure 2.5 Calibration graph drawn from class results.

Exercise 3 Sea Water Density

Method

Part A

1. Sharpen two pencils to exactly the same length.
2. Now dissolve a teaspoon of salt in 100 mLs of water.
3. Place the two test tubes in the rack provided and 3/4 fill one with fresh water and the other with salt water.
4. Now place the pencils in each.
   - Can you see a difference? Which is higher? Record your results in Figure 3.1 under Part A.

Part B

5. Now take out one of the pencils and use a pen and ruler to mark down 0.5 cm intervals as shown in Figure 3.1.
   - We will call this your hydrometer.
6. Fill each of the 5 test tubes with the solutions labelled 0, 10, 20, 30, and 40 grams per litre.
7. Now carefully drop the pencil into each test tube as shown in the photograph.
   - Read the scale and record your results in the Table in Figure 3.2.
8. Now repeat the experiment with the other test tubes.
   - Record each of the results in the table as before.

Materials and Equipment (per group)

Part A

- 100 mL beaker
- 5 test tubes (equal size)
- 2 pencils
- test tube rack
- 100 mL beaker
- teaspoon and salt

Part B

- 5 test tubes (equal size)
- pen and ruler
- 10 mLs of 5 saltwater standard solutions labelled 0, 10, 20, 30 and 40 grams per litre

Questions

1. Now plot a graph of the standard solution (x axis) versus the hydrometer reading (y axis).

   Describe how the graph changes.
2. What does a hydrometer measure?
3. Which is more dense, salt water of fresh water?
4. If the tide was coming into a river, would the sea water be found on the top of the fresh water or the bottom?
5. What do you think a salt water wedge is in an estuary?

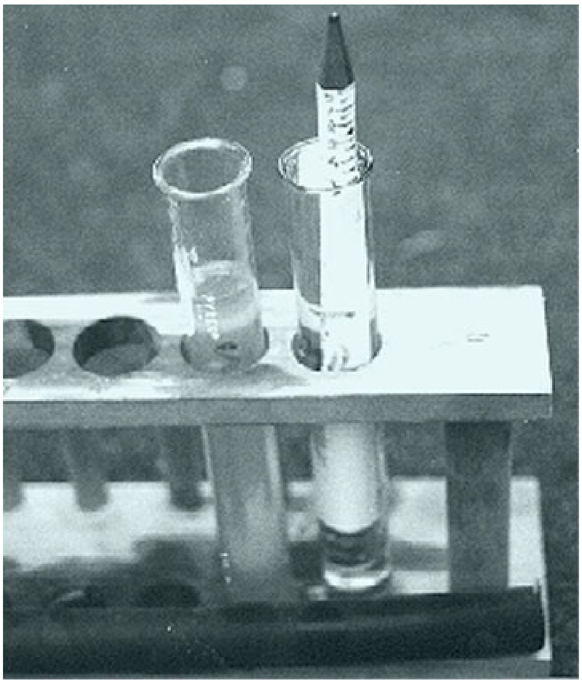

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Figure 3.1 Experimental set up for Part B

Results

Part A

Which pencil floated higher? ________________________________

Part B

Data table

Standard solution	Hydrometer reading
0 g/L	
10 g/L	
20 g/L	
30 /L	
35 /L	

Figure 3.2 Results and questions

EXERCISE 4
WAVES

PART A WAVE VELOCITY

Method

1. Read the information box in Figure 4.1.
2. Use the ruler to mark two points 15 and 30 cm out from the end of the tray as shown in Figure 4.2.
3. Now fill the tank with 700 mLs of water and place the piece of wood at one end.
4. Practice rocking the piece of wood with your finger as shown so that a wave can be made to travel from one end of the tray to the other.
5. Now make a wave 15 cm long by consistently rocking the piece of wood at the same frequency.

   When the wave length is 15 cm, count how many waves pass the 15 cm mark in 15 seconds using your watch.

   • Record the number in Figure 4.3 in the frequency section under the 15 cm wavelength.

   • Çalculate the velocity of the 15 cm long wave in cm/sec by using the formula supplied and write it in the space provided.
6. Now make a wave 30 cm long and again count how many waves are produced in 15 seconds using your watch.
   - Record the number in Figure 4.3 in the frequency section under the 30 cm wavelength.
   - Now calculate the velocity of the 30 cm long wave as before and write your result in the space provided.

Questions

1. What is the speed of a wave called?
2. What is the distance between waves called?
3. What is the number of waves per second called?
4. Compelete the sentences:

   a. We observed 20 waves passing the 15 cm point in 10 seconds.

      The _____________ of these waves is therefore 2 waves per second.

   b. Waves of different frequency in the same depth of water have different ____________ .

   c. Waves of different frequency in the same depth of water have the same ____________ .

Now turn over and complete Part B.

MATERIALS AND EQUIPMENT (PER GROUP)

Equipment required

Part A

- white tote tray (tidy box)
- 700 mLS of water
- ruler and permanent felt pen
- timer with second hand
- 2 lengths of wood 50mm x 25mm (see Figures 4.2 and 4.5)

Part B

- two cups of washed sand
- 10 small rocks (optional)

Information box

The speed at which waves travel is related by three things or variables in this experiment.

- The distance between waves is called the wavelength and has the symbol lamba (λ).

  Distance is measured in kilometres or metres.

  1 km = 1000 m
- The number of times a wave passes a point in a second is called the frequency and has the symbol (f).

  Time is measured in hrs. or seconds.

  1 hr. = 60 x 60 seconds
- The speed that the wave is travelling is called the velocity and has the symbol (v).

  Velocity has a direction and a speed.

  Direction can be up, down, north, south, east or west.

  Speed is measured in Km/hr. or m/sec.

Now these three variables are related by the formula:

Velocity = wavelength x frequency

or $v = \lambda \ f$

In this experiment we want investigate each and get some practice at using the formula $v = \lambda \ f$.

Figure 4.1 Information on wave velocity

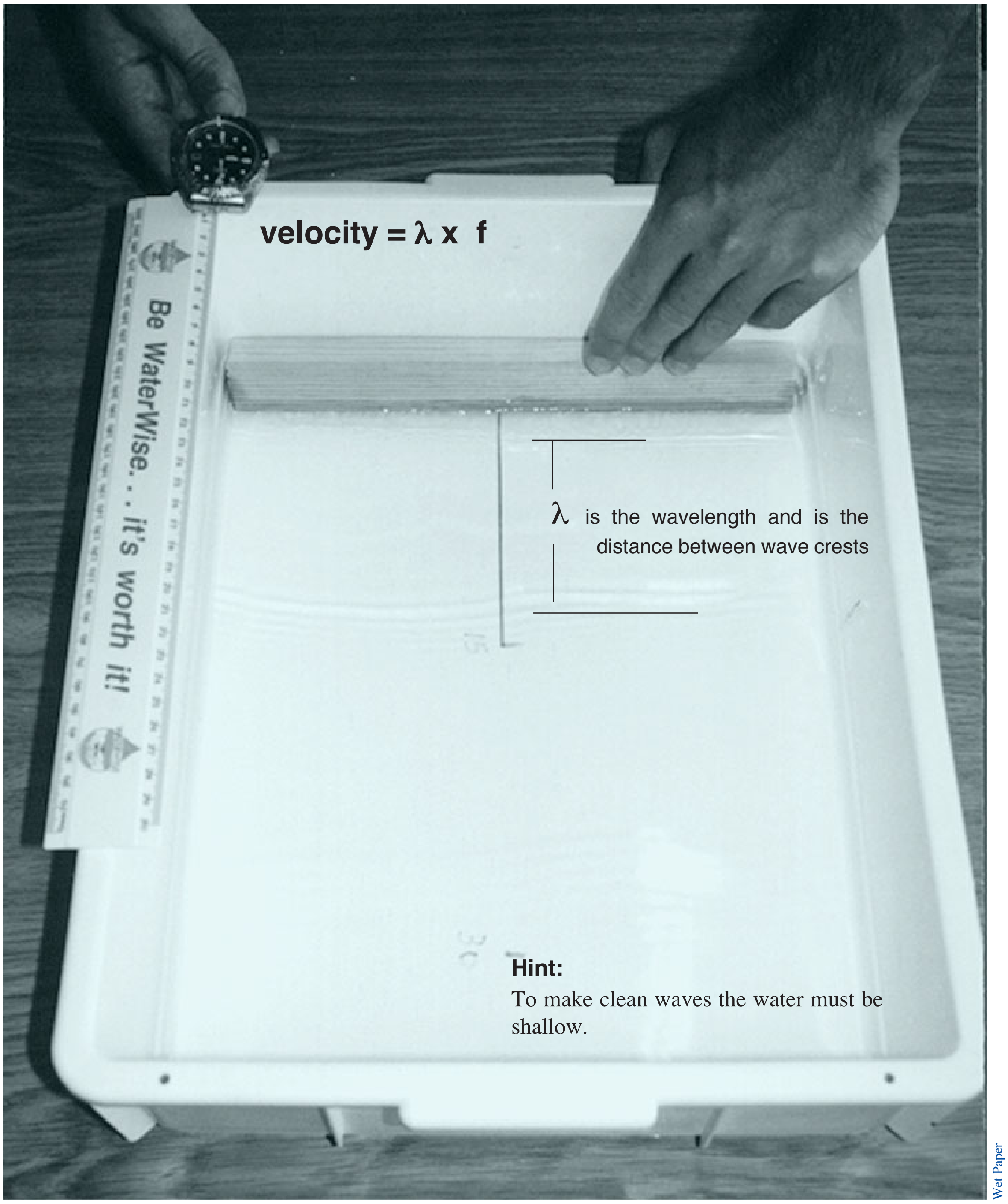


Figure 4.2 **How to calculate the velocity of waves**

Wave length	15 cm	30 cm
Frequency		
Velocity $v = \lambda f$	v = 15 x ________ 15 = __________cm/sec	v = 30 x ________ 15 = __________cm/sec

Figure 4.3 **Velocity of waves**

Part B Wave refraction

Method

1. Read the information box in Figure 4.4.
2. Add sand to the tray to make a shallow sandbank as shown in Figure 4.5 B. Use the short piece of wood as shown in Figure 4.5 A to make a even sloping beach by smoothing out the sand bank so that the wave can travel over it.
3. Now generate waves of about 15 cm wavelength and observe carefully what happens when the wave passes over the sandbank.

   Make a drawing of the experimental set up and record your results in your notebook.
4. Now add another cupful of sand to make a headland as shown in Figure 4.6 and generate waves to pass the headland. Watch carefully what happens and the direction the waves are travelling as they pass the headland.

   Record your results in your notebook, and answer questions 5 - 9 below.

Questions

5. What happens to waves as they travel into shallow water?
6. What causes these changes?
7. Define the term refraction?
8. What are orbit fields and how are they affected as they pass into shallow water?
9. Turn to Page 327 of your textbook and read the section on waves. Describe a perfect surfing break.

Option

1. Read the information about groynes in Figure 4.4.
2. Empty the water out of your tray and tray and construct a groyne in your beach out of the rocks supplied.
3. Now generate waves at the groyne and observe the movement of sand around the rocks.
4. Answer the questions below

Questions

10. What is a groyne and how is it different from a training wall?
11. Make a drawing of the movement of sand around a groyne and describe what happens.

Research

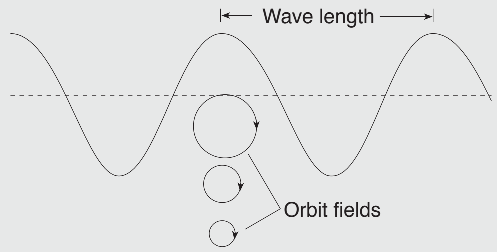
Research the role of a coastal engineer and describe what type of projects they undertake.

Read this

Refraction

Waves gain their energy from the wind and move through the ocean at different speeds.

All waves have a height and wave length. Their energy is stored in circles called orbit fields as shown by the diagram below.



As waves pass from deep water to shallow water they slow down and bunch up because the sand absorbs the energy from the wave's orbit field.

If waves approach the beach or move past a headland with a large amount of sand, the waves slow down and bend because the sand absorbs the energy from the orbit field.

The bending of waves is called **wave refraction** and is a very useful science fact for surfers.

Surfers rely on wave refraction to catch waves. The more perfect the ocean floor, the more perfect the wave. Reefs and headlands are hard structures and have consistent waves that refract making them great places to surf over.

Figure 4.4 **Orbit fields and refraction**

Groynes

Sometimes rocks or training walls are placed in position to trap sand or reduce the wave action at river mouths so ships can enter and leave local fishing ports.

Rocks that are placed out to sea to alter the patterns of waves at river moths are called training walls.

Rocks that are placed in the surf zone to trap sand are called groynes as shown in the figure below.

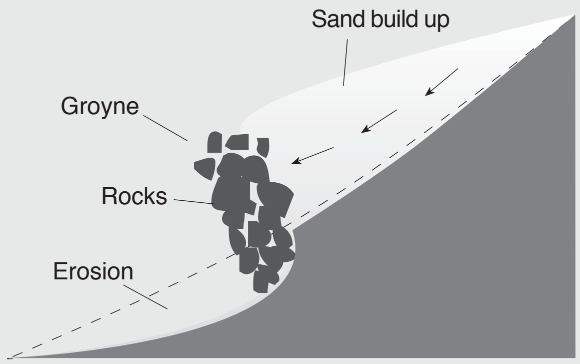
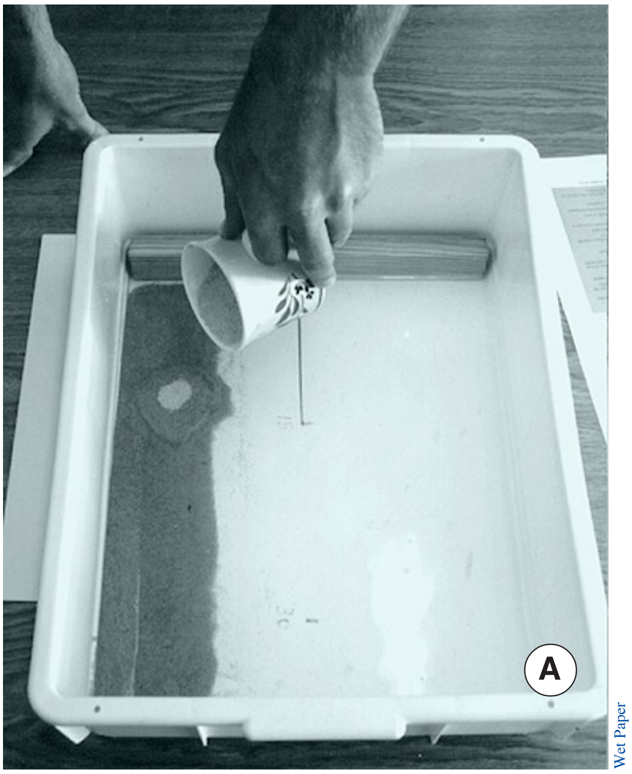


Figure 4.5 Groynes

Figure 4.5 **How to slow down a waves**



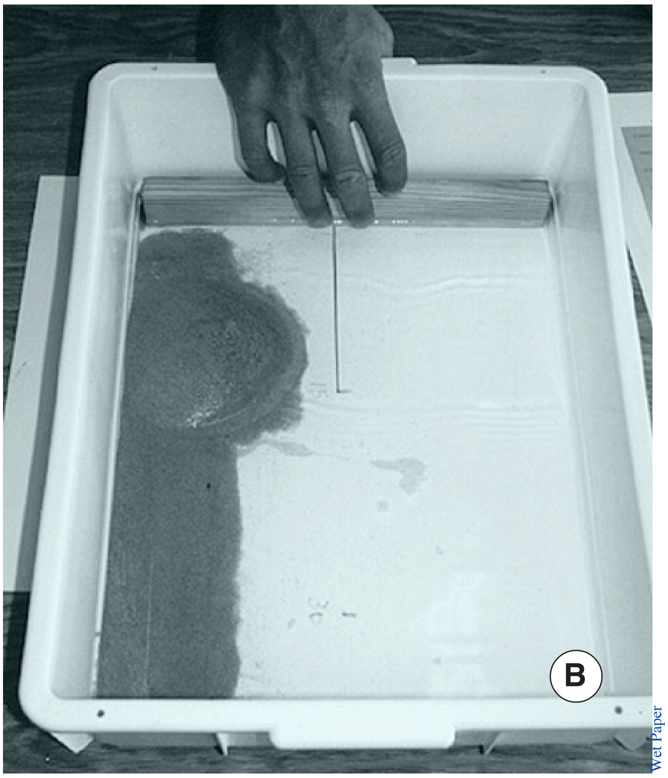


Figure 4.6 **Headland situation**

Exercise 5
Longshore drift

Method

1. Set up your tote tray as shown in Figure 5.1 and add the 4 - 5 condy's crystals from a paddle pop stick to the point labelled A in Figure 5.1.
2. Generate waves at a frequency of about 3 per second using your wave generator.
3. Observe the direction of travel of the dye in the water and record your results. You should see something like that shown in Figure 5.2 A.
4. Now tip the tray to one side, empty the water carefully, scrape out any excess dye and refill the tray with water.
5. Add more sand to make a headland as shown in Figure 5.2 B.
6. Now add 2 - 3 crystals near the headland as shown and generate a series of waves. You should see something like that shown in Figure 5.2B.
7. Make drawings and a description of your results in your notebook.

Questions

1. What is the name of the current generated by waves as they move along the beach?
2. Is the current around a headland different from that on a straight beach.
3. Use your textbook index to locate the term rip currents. Draw a diagram to show how these are formed and label the main parts of a rip.
4. What should you do to get out of a rip current?
5. Use your textbook to locate the section on sand systems and complete Figure 5.3 to indicate where sand is:
   - made;
   - enters the beach system;
   - moves on and off the beach and
   - leaves the system.
6. Write a paragraph tracing the path of a sand grain from a mountain range to becoming part of silt in an estuary.

Materials and equipment (per group)

Equipment required

- white tote tray (tidy box)
- condy's crystals and paddle pop stick

- Care should be taken to use the very smallest amount of condy's crystals to get the best result

Extension

1. Experiment with different places. Does the dye move faster in deep water or shallow water?
2. Try making a groyne of sand along the beach and study the effects of currents around this groyne.,
3. Design a motor to generate waves.
4. Make a bigger tank out of acrylic plastic as shown in Figure 5.1. Your manual arts department can help.

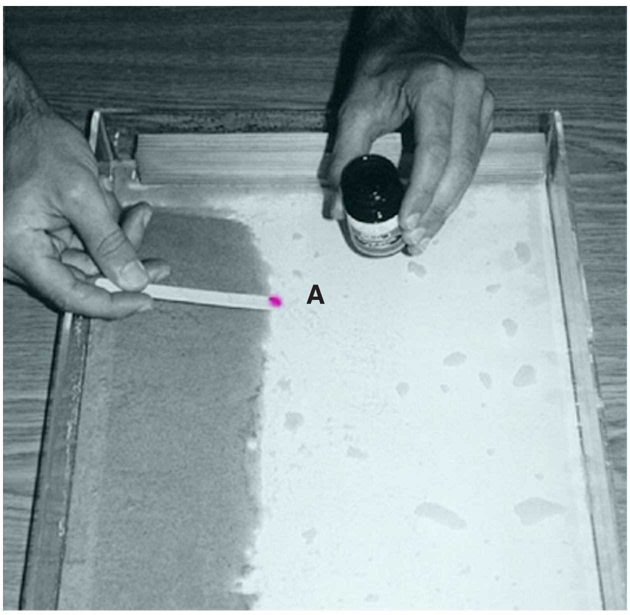


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Figure 5.1 **Experimental set-up**

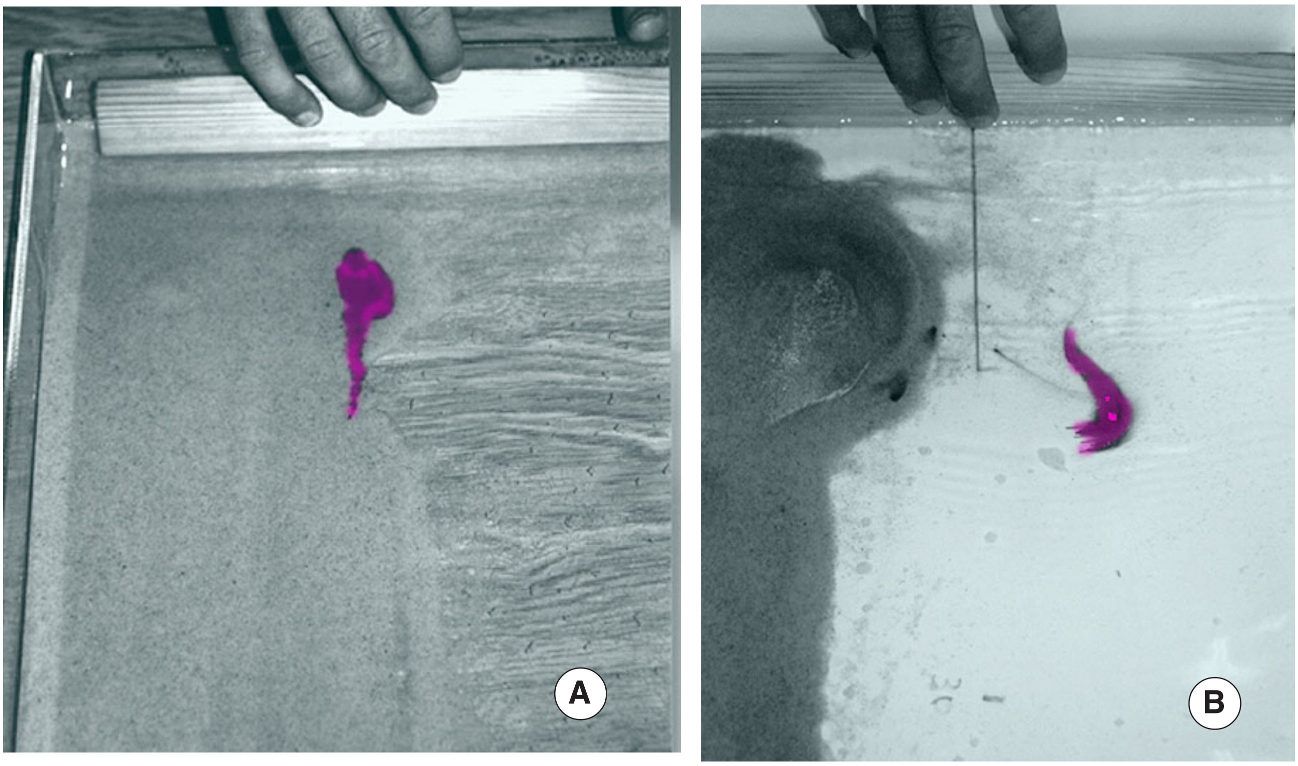


Figure 5.2 **Results from the experiment**

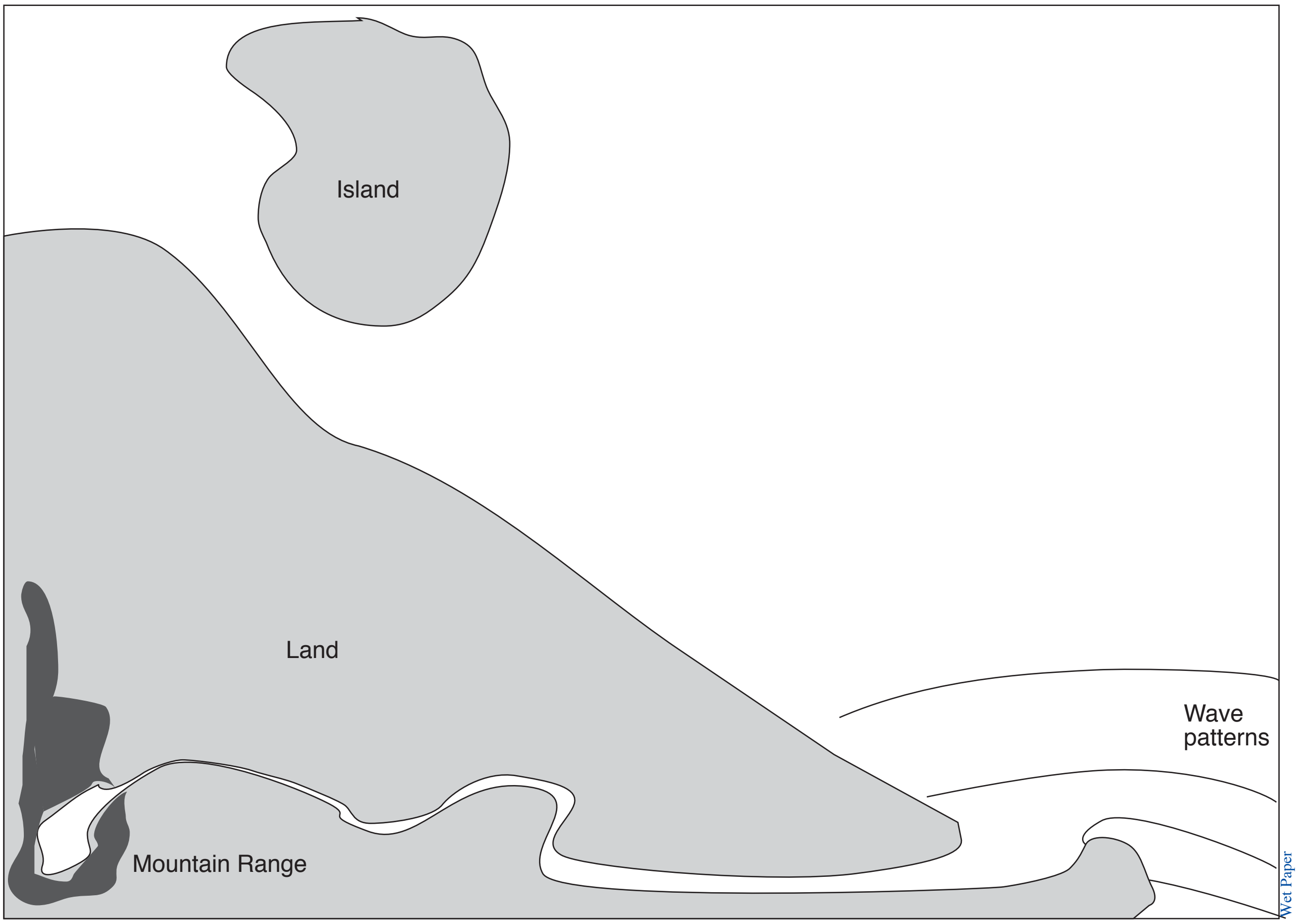


Figure 5.3 **Information for Questions 3 and 4**

Exercise 6 Longshore drift field work

Method

You are going to throw floating biodegradable objects into the longshore current. One of the objects will be in close and the other as far out as can be safely thrown.

1. Mark out 5 stations, 15 metres apart on the beach, with your foot. Use the compass to mark in N, S, E and W.
2. Collect an orange (or other biodegradable material) and arrange with your partner who is going to throw the object in close and who is going to throw the object far out.
3. At a prearranged signal, such as a whistle, look to your teacher. At the second signal, and it must be emphasised **prearranged,** you cast your oranges into the sea as planned and the timekeeper starts the watch.
4. You then follow your oranges and any variations in their movements. If the orange comes in, you should throw it out again.
5. After one minute the timekeeper signals and you are to mark the position of your orange in the sand opposite where it is floating in the sea. Repeat after two, three, four and five minutes.
6. After five minutes go back and measure the distances and assess the drift direction. Record these in the data tables as shown in Figure 6.1.

Questions

1. Which direction did the long shore current flow?
2. What was the estimated speed of your orange?
3. Which travelled fastest — inshore or far out?
4. If an oil spill occurred offshore and was unable to be cleaned up, how long would it take to pollute the nearest town?
5. Name any other way that longshore drift could be measured.

Materials and equipment (per group)

Equipment required

- note pad and pencil
- straight stretch of beach
- two oranges
- watch with second hand
- meter rule or tape

Name ______________________ Teacher ______________________

Team Station ________ Orange throw (circle one)
Short Long

Date ______________

Rip Yes ☐ No ☐

Wind speed ______________________

Direction ______________________

Surf height ______________________

Ocean substrate offshore __________

Short throw

Minutes	Drift direction	Distance

Notes ______________________

____

____

Long throw

Minutes	Drift direction	Distance

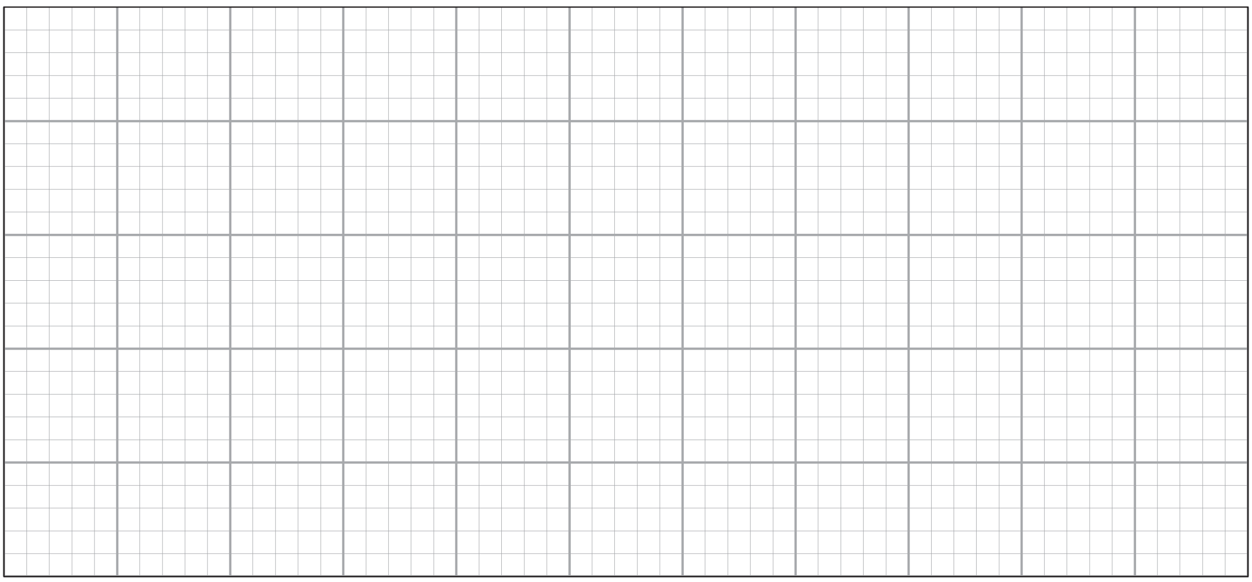
Notes ______________________

____

____

--------- Short ———— Long

Distance travelled (m)



Wet Paper

Time (minutes)

Figure 6.1 **Students may make one copy of this page so that they can attach their answers before handing in for marking.**

Exercise 7 Forces that cause ocean water to move

Questions

Use pages 297 and 325 – 329 from your textbook to answer the following questions.

1. Match the statements in the table in Figure 7.2 with corresponding numbers above the table.
2. What is the difference between a rising sea and a developed swell.
3, Study the weather map in Figure 7.1 and calculate the size of the fetch that would be generating waves for Sydney, Perth and Brisbane.

Research topics

There are other forces than cause ocean water to move. Use library references to find answers to the following questions.

1. What types of waves do tides generate? Give an example of how a tide can generate a wave.
2. What is a gyre?
3. What is a coriolis force and how does if generate waves? What is the Ekmann spiral?
4. What type of wave can an undersea earthquake generate?

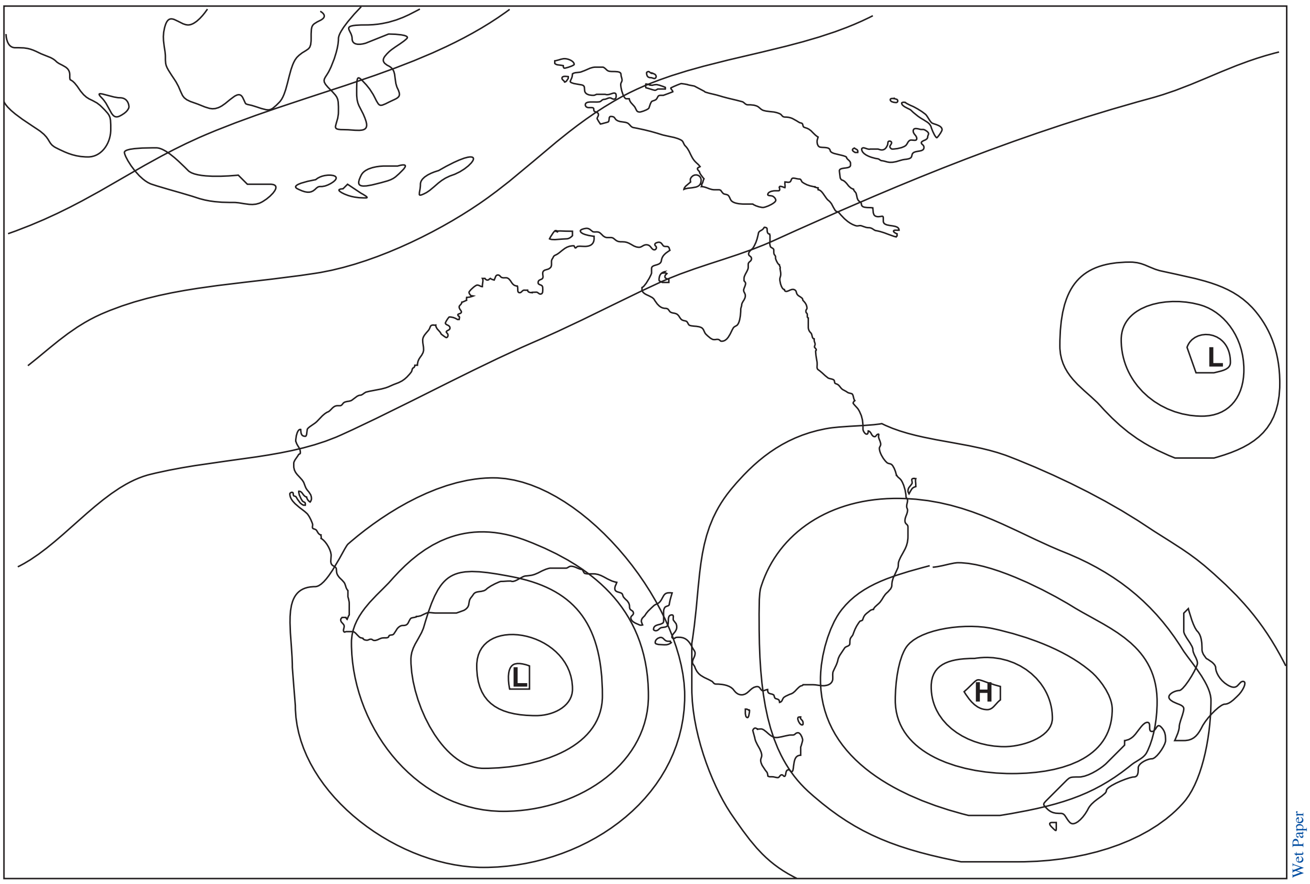
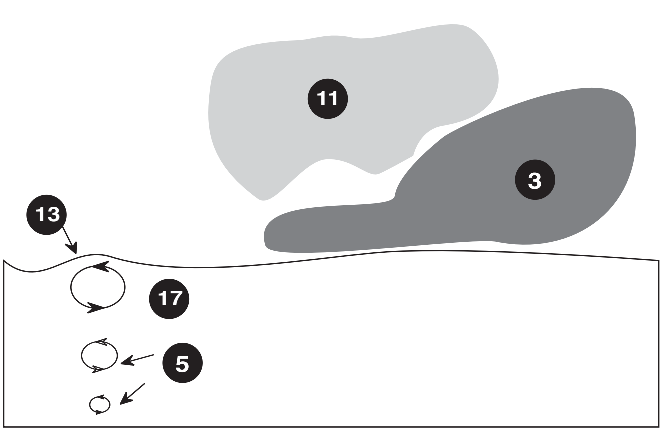
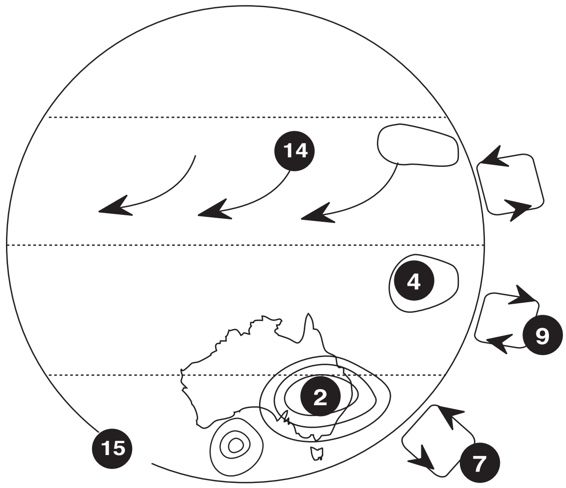
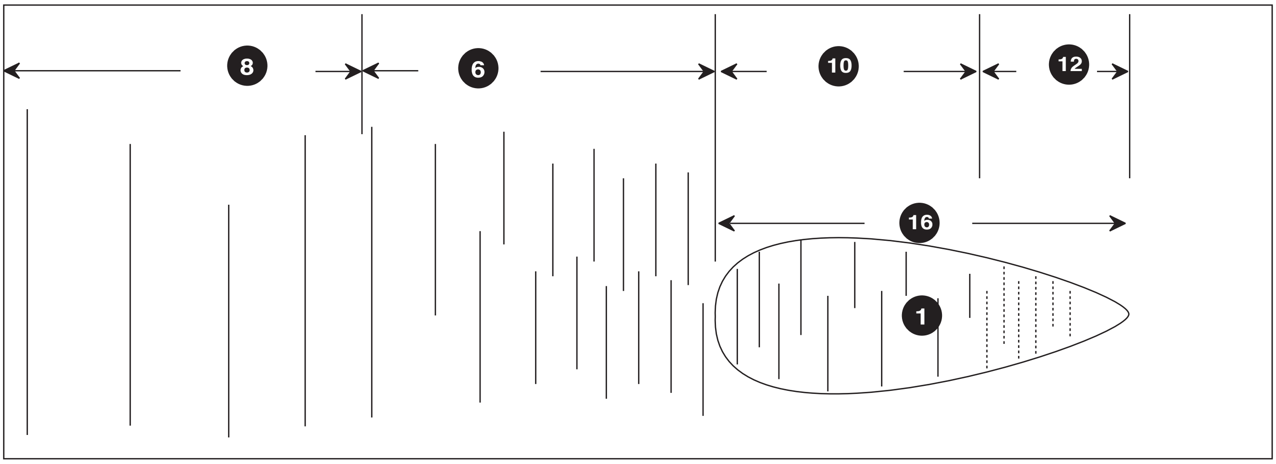


Figure 7.1 **Weather map. Students may make one copy of this page so that they can attach their answers before handing in for marking.**







Statement	Matching number
A circular motion is set up, called a wave orbit.	
The water in the orbit moves in a circular motion while the energy in the wave moves on.	
Ripples.	
The sun causes hot air to rise.	
Fully developed swell.	
Wind makes ripples.	
Hot air rises.	
Water under the wave moves in a circle.	
North East Trades.	
Rising sea.	
Cool air falls creating high pressure systems.	
Low pressure system — L.	
High pressure system — H.	
Hot air rises creating low pressure systems.	
Fetch.	
Wind.	

Figure 7.2 **Students may make one copy of this page so that they can attach their answers before handing in for marking.**

Exercise 8 Ocean Currents

Questions

1. Indicate in Figure 8.1 the pattern of surface currents that pervade the oceans of the world. Then, using the information from Figure 8.2, mark in the following currents:
   a. South Equatorial Atlantic and Pacific
   b. North Equatorial Atlantic and Pacific
   c. North Atlantic Current
   d. The Gulf Stream
   e. Counter currents in Pacific and Atlantic
   f. Humboldt Current
   g. Aleutian Current
   h. Kuroshio Current
   i. Oyashio Current
   j. East Australian Current
   k. West Australian Current
   l. Antarctic Circum Polar Current
   m. el Nino

3. The speed of ocean currents is generally 8 km / day. The Gulf Stream and Kurishio Current have currents which range in speed from 100 km - 150 km per day.

   Suggest some explanation for these speeds.

4. Outline two factors that may cause ocean currents. Explain how they would work.

5. Turn to Page 393 in your textbook and describe three methods that can be used to measure ocean currents. Use diagrams to illustrate your answer.

Research topics

1. What other type of currents may be found in our oceans?

2. Define the term Corioles effect and explain how it effects the ocean currents.

3. Why was the discovery of the Gulf Stream so important to trade between North America and England?.

4. What is el Nino? Indicate on your diagram how it affects the Peruvian fishing industry.

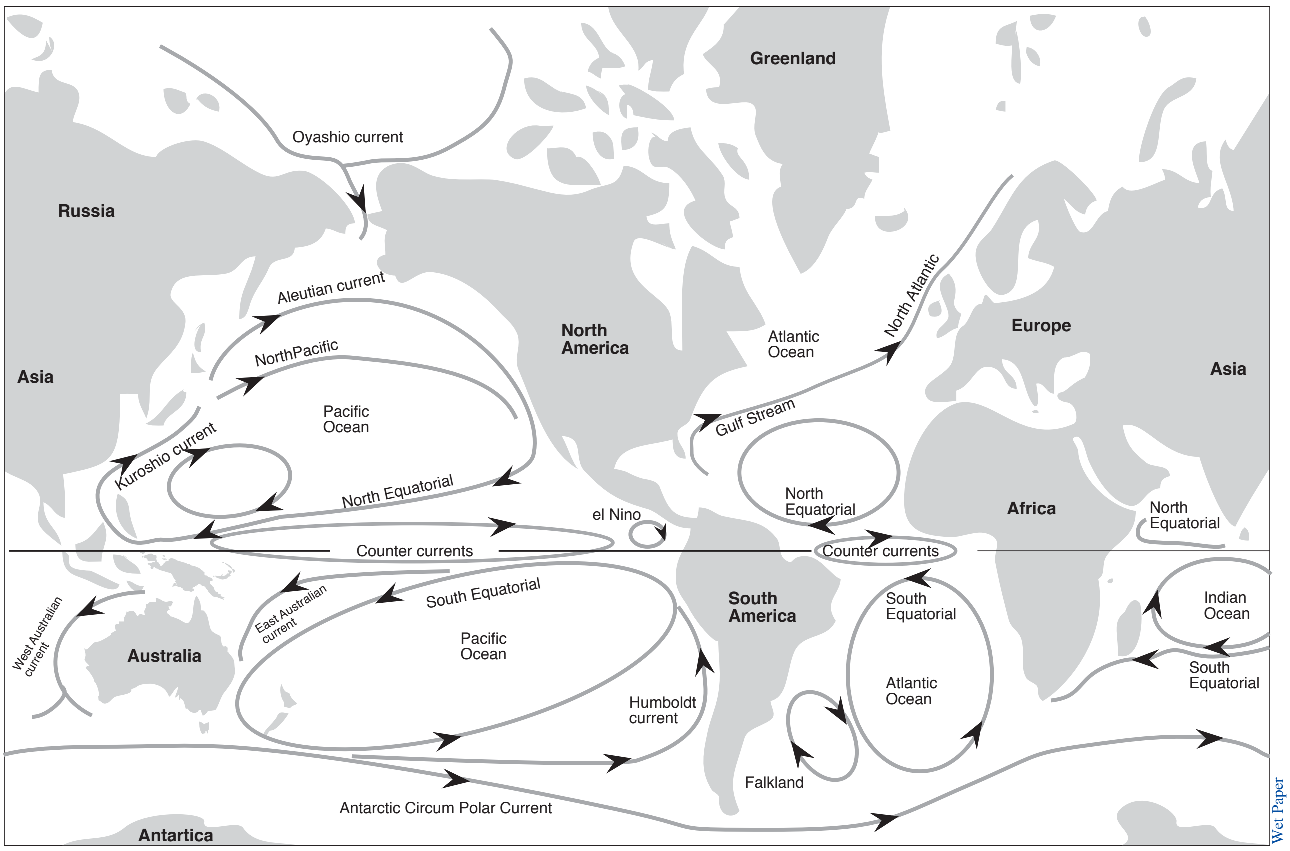


Figure 8.1 **Major ocean currents (approximations only)**

Figure 8.2 **Students may make one copy of this page so that they can attach their answers before handing in for marking.**

Exercise 9 Currents around Australia and New Zealand

Questions

Use a atlas and pages 298 and 299 of your textbook to answer the following questions.

1. Mark the following places on Figure 9.1:

   Cape York, Perth, Sydney, Darwin, Broome, Carnarvon, Albany, Esperance, Port Lincoln, Adelaide, Kangaroo Is, Melbourne, Port Campbell, Launceston, Hobart, Dunedon, Christchurch, Auckland, Wellington, Port Macquarie, Brisbane, Townsville, Thursday Island, Port Moresby, Timor.

2. Use the information sheet and your textbook to name the currents 1 - 6 around Australia in Figure 9.2 and name the cities and town identified in question 1 that they pass.

3. What is happening at the places labelled A and B in Figure 9.2?

4. Use the information sheet to answer the next three questions.

   a. The Coral Sea is almost a metre 'taller' than the Tasman Sea. What does this cause?

   b. In winter, the Tasman Sea cools at the surface. What does this cause?

   c. What does the term EAC refer to?

Extension web sites

Try looking up these WWW. references

http://seawifs.gsfc.nasa.gov/ocean_planet.html

http://www.pmel.noaa.gov/toga-tao/el-nino/home.html

http://nic.fb4.noaa.gov/data/cddb/

http://www.marine.csiro.au/

http://www.marine.csiro.au/LeafletsFolder/oceanresearchleaflet.html

http://www.marine.csiro.au/PressReleasesfolder/5sep96.html

Materials and equipment (per group)

Equipment required

- Access to computer, modem and internet.

Information sheet

http://www.marine.csiro.au/LeafletsFolder/oceanresearchleaflet.html

Write for information sheet No 3, June 1987 on the East Australian Current by George Cresswell c/-

CSIRO Division of Oceanography

Marine Laboratories

GPO Box 1538

Hobart Tas. 7001

Figure 9.1 **Australia, PNG, Timor and New Zealand**

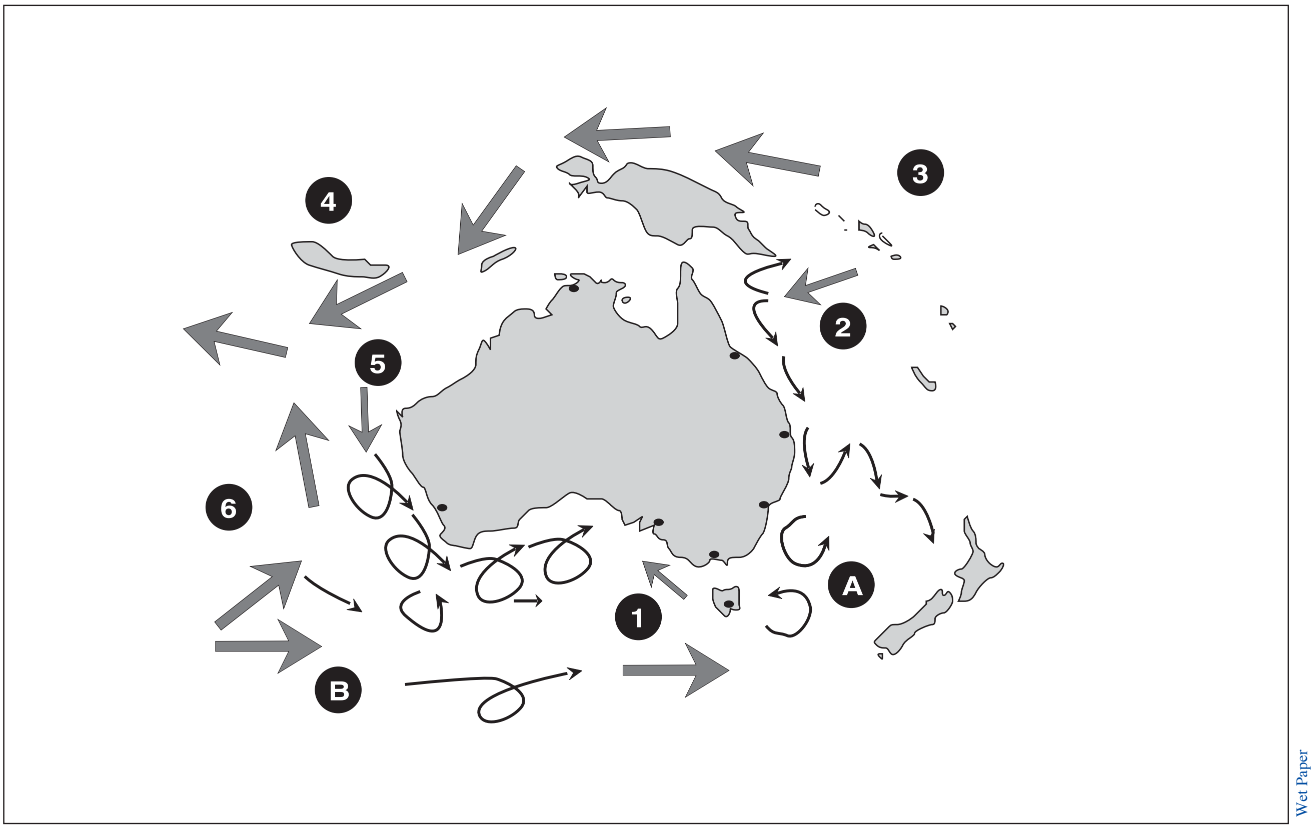


Figure 9.2 **Australian and NZ currents (CSIRO)**

Exercise 10 Local Currents

Method

Part A Making a drogue

1. Attach the plastic bottle to the broom stick with lots of tape and cord as shown in Figure 10.1.
2. Drill a hole in the bottom of the broom stick and tie on the weight on with another piece of cord.
3. Test your drogue in a swimming pool or wheelie bin.
4. Make adjustments so that the drogue floats and add a flag.

Part B Field work

1. Tie 10 metres of cord to the drink bottle.
2. Select a place such as a jetty where the current is running and you can launch your drogue.
3. Lower the drogue into the water and tell your partner to time how long it takes for the drogue to run out to the full length of the 10 metres of rope on a prearranged signal.
4. When you partner is ready, release the drogue and observe what happens.

Materials and equipment (per group)

Equipment required

- electrical tape
- empty platci bottle
- old broom stick
- drill
- divers weight
- 11 metres venetian blind cord
- coloured materials (for flag)
- watch with second hand
- handbearing compass

5. Use the hand bearing compass to determine the direction of the current .
6. Using the formula:

   Speed = distance / time;

   calculate the speed of the current and record it in the space provided in Figure 10.3.
5. Repeat your experiment twice and average your results.
6. Now answer the questions in Figure 10.3.

Extension

7. You may like to try to see if the current speed changes at different times in the day.
8. Turn to page 165 of your textbook and read about the rule of twelfths. How does the tide effect local currents?

Wet Paper

Figure 10.1 A home made drogue


Wet Paper

Figure 10.2 **Current measurement**

Results

Length of rope ____________ Time to run length out _________________

Speed of current
(Distance/time) ____

Direction of current ______________________

Questions

1. How fast was your current?

2. In what direction did it go?

3. What causes currents?

4. Do you think currents will change during the day and if so what could cause these changes?

Figure 10.3 Summary of current data

Exercise 11
Ocean shapes

Questions

Use pages 287 – 298 of your textbook to answer the questions below.

1. In Figure 11.1:
   a. What is the difference between A, B, C and D?
   b. Mark the scales depth and distance.
2. Mark in the following ocean features in Figure 11.1.
   - Continental margin
   - Continental rise
   - Ocean basin
   - Continental slope
   - Ocean ridge
   - Continental shelf
   - Abyssal plain
3. In Figure 11.2:
   a. Use coloured pencils to show the difference between the abyssal plain, continental shelf and continental slope.
   b. Identify the names for A - H.
   c. At which part of the Australian continent is the shelf the largest?
   d. Off which Australian state is the slope the greatest? Give reasons for your answer.
   e. How many abyssal plains surround Australian and off which states are they found?
4. In Figure 11.3:
   a. What is the pressure in atmospheres at A, B, C and D?
   b. What is E supposed to represent and what is the oceanic feature it is in?
   c. How deep is it at point E?
   d. Where would the abyssal plain be on this diagram?
5. Using information from the box in the next column, answer the following questions:
   a. How deep are trenches?
   b. What is a sea mount?
   c. What was the challenger depth and what was the name of the vessel which went down into it?
   d. Is petrol lighter than sea water?

The Pacific Ocean continents are fairly flat and are surrounded by a continental shelf. There are however some deep places off the coast of New Zealand, New Hebrides and Solomon Islands. Here the abyssal plain plunges to a depth of some 10 kilometres in the deepest part of our oceans called **trenches**.

Bordering these trenches can be ridges, plateaus and rises. On these areas it is common to find **seamounts**, which can be formed when undersea volcanoes become extinct. Sometimes the volcanoes are above the sea and form island chains such as **Fiji**, **Tonga** or the **New Hebrides Group**. Other volcanoes lie submerged and can have reefs growing on top to form a capping.

In 1960 two scientists made a record dive into the deepest part of the ocean. This was into the challenger deep in the Pacific, over 10,000 metres and over 1000 atmospheric pressure. The vessel was a bathyscape called the **Trieste.**

Figure 13 on page 289 of your textbook gives you some idea of the depth and scale of this dive and the tanks involved to control the vessel. Eleven of these tanks were filled with 120,000 litres of petrol. The petrol was lighter than water and this made the craft light enough to float. One tank at each end was left empty just before the dive. Then the tanks were opened and sea water flowed in and the bathyscape began to sink. To come to the surface the Trieste released its pellets quickly and once on the surface the vessel floated.

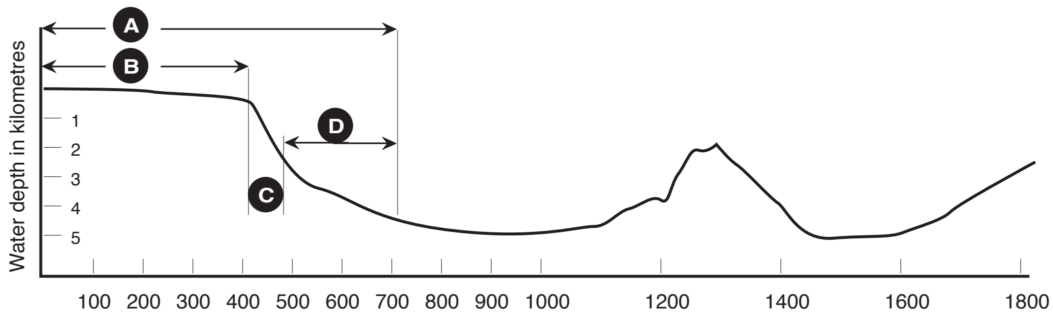


Figure 11.1 Ocean zones
Wet Paper

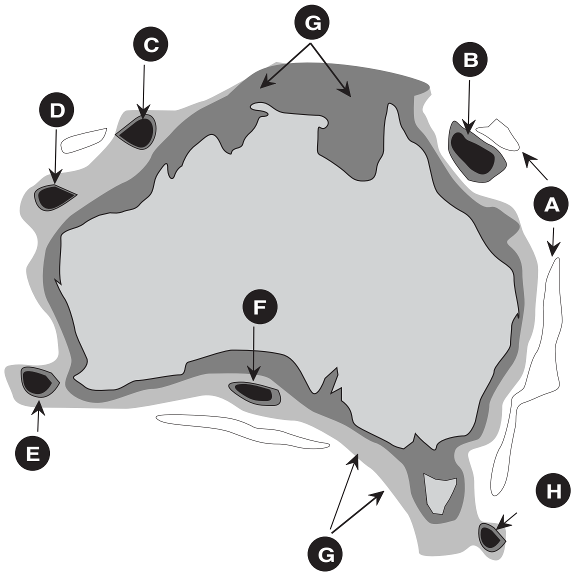
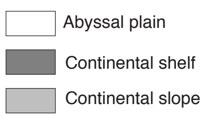


Figure 11.2 Continental shelf
Wet Paper



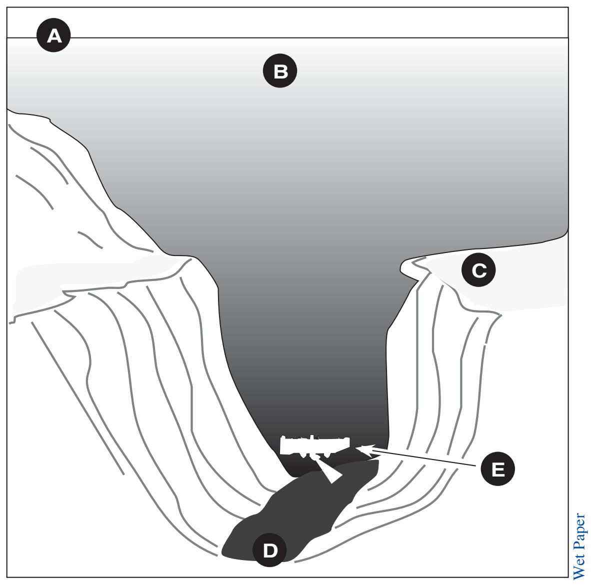


Figure 11.3 Ocean depths

Exercise 12 Hypothetical Bay

Method

In this activity you will construct a model, as shown in Figure 12.1, from a template as shown in Figure 12.2.

1. Look carefully at Figure 12.2 and note the different depths marked out by the bathymetric lines 4, 6, 8. 10, 20 and 30 metres respectively.

   See which contour lines are above and below water level. Above sea level is positive and below is negative.

2. Cut out a piece of A4 cardboard, write 40 m on it and place it to one side.

3. Place a piece of carbon paper between a copy of the template (Figure 12.2) and a piece of A4 cardboard. Make sure the carbon is arranged so that a copy will be made onto the cardboard sheet.

4. Look at Figure 12.2 and find the 30 m bathymetric line. You will see outside the margin the letters A1, A2, B2, C, D, E, F, and B1. The letters D and C will be at the top corners of the page and E and F at the bottom corners.

   Starting with point A1, trace over the points from A1 along the 30 m bathymetric line to A2. Then keep tracing through the points C, D, E, F until you get back to A1 with your pen. Remove the template and carbon paper and you should see the 30 m depth traced out.

   Use scissors or a paper cutting pen to cut this shape and use the glue to stick this onto the 40 m depth you placed to one side.

5. Place the carbon paper again behind the template and another piece of A4 cardboard.

   Find the 20 m bathometric line and trace over the points B1, 20 B2, C, D, E, F and back to B1.

Materials and Equipment (per group)

Equipment required

- 6 pieces of A4 crinkle cardboard
- carbon paper and glue
- paper artist's cutting knife
- copy of Figure 12.1

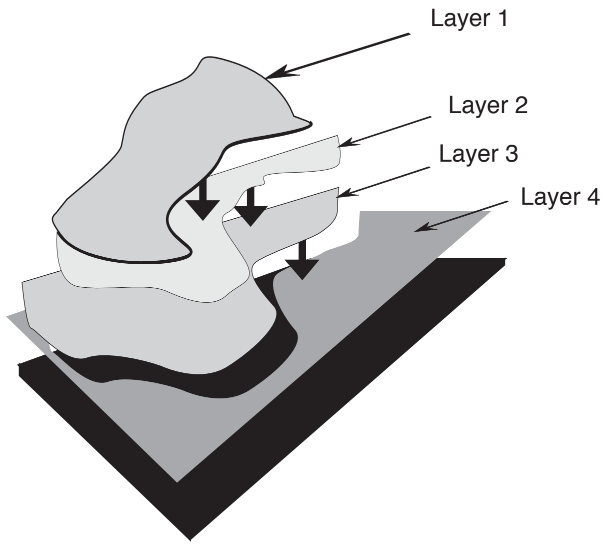


Figure 12.1 How the various layers are added to make up the model
Wet Paper

6. Use scissors or paper knife to cut out this shape and glue it over the 30 metre depth cardboard sheet.

7. Now repeat for each of the depths as shown in Figure 12.2 to make up your model of Hypothetical Bay.

Questions

1. Turn to Exercise 26, find Figure 26.2 and match the names of the following places with your model:

   Evans Head, Halpin Hill, Jensen River, Maloney Bay, Perry Shoals, Mt. James, Lynch River, Heyer River, Wiley Island, Sumpter Island, Maclean Reef, Rogers Reef, Col's Reef, Tony's Wreck Reef, Langley Reef, O'Connor Reef, McGarvie Point, Tulip Inlet, Watson Swamp, Claridge Inlet, Moffatt Headland, Coleman's Reef, Critchley Peak, Pitman Point, Townsend Bay, Kaigan Point, Steggles Beach, Surfrider Bay.

2. As a tourist operator you have to identify places where tourists will have a great time. Weather and sea conditions are important. For each of the following, mark in where you would advise a family to go if they wanted to have a great day out.

   a. It is blowing 20 knots from the north and the children want to go for a surf with their body boards.

   b. Grandma and grandpa want to do a bit of quiet fishing. It is raining and overcast with a 10 m south easterly swell.

   c. A group wishes to study a mangrove swamp in the morning and then climb a peak on an offshore island in the afternoon.

   d. A group wants to go deep sea fishing. The weather is fine with a 1 metre sea from the east.

   e. A dive group wants a reef with great visibility. It is fine with a 10 knot westerly.

   f. A surf contest is planned where spectators can see surfers ride two metre waves.

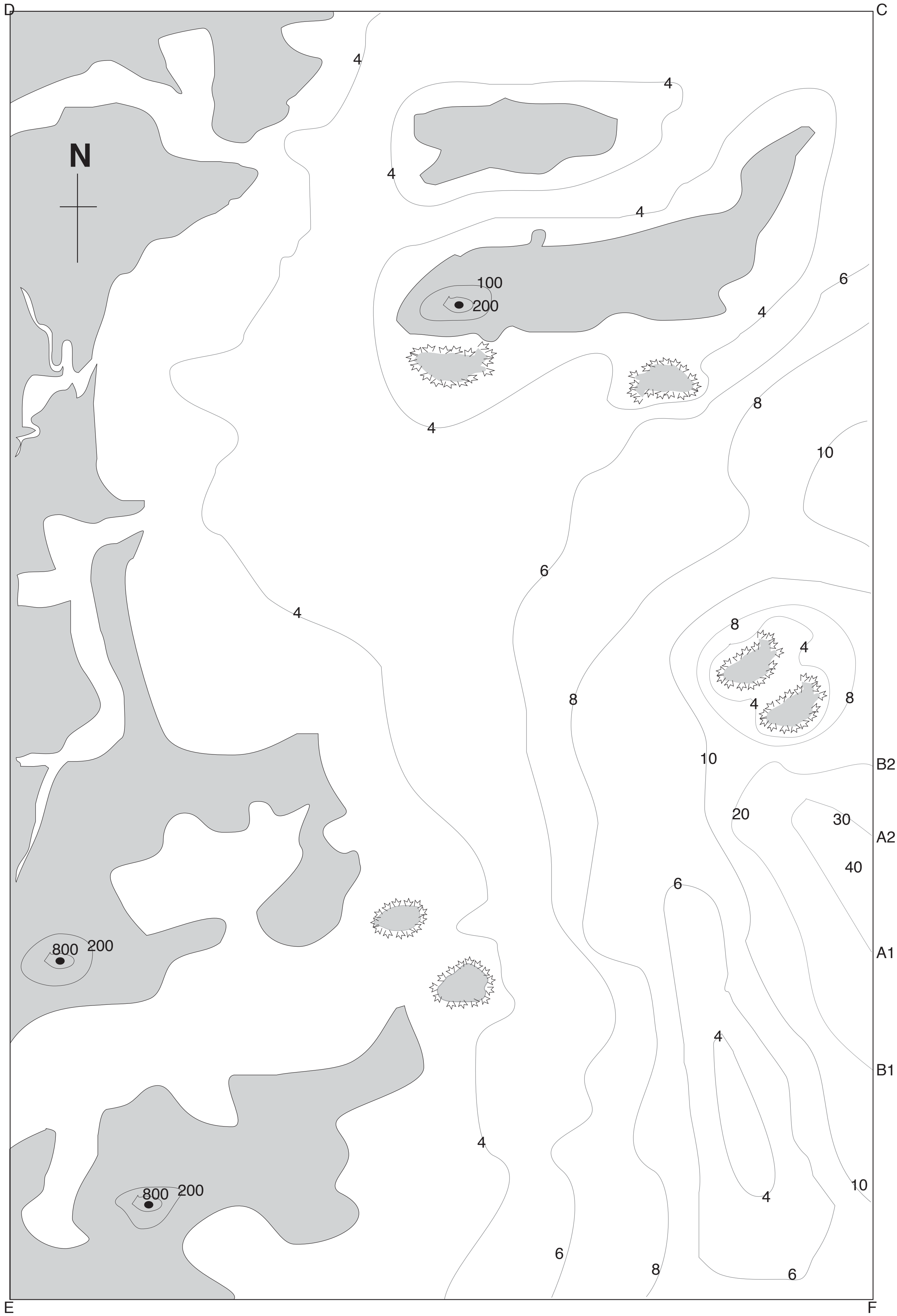


Figure 12.2 Hypothetical Bay template. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 13 Hypothetical Reef

Materials and equipment (per group)

Equipment required

- pieces of cardboard scrap and glue
- paper artists cutting knife

Method

1. Look carefully at Figure 13.2 and identify the different water depths. Note that at -2 m, there are coral outcrops that rise above the sea floor to sea level and that there is an island 2 metres above sea level.
2. Use a coloured pencil to identify the following:
   - ocean floor (-6 m)
   - lagoon (-2 m)
   - windward side
   - inner coral zone (-1 m)
   - leeward side
   - outer coral zone (-1 m)
   - bommies (-1 m)
   - inshore gutter (-1 m)
   - reef crest (0 m)
   - coral island and beach (+1 and 0 m)
   - algal rim (0 m)
   - island vegetation (+2 m)
3. Note carefully the heights of each section and make a verbal description to your partner.
4. Build a three dimensional model of the coral island, as follows:
   a. Cut out the level between the -5 m and -6 m levels. The -6 m level represents the ocean floor and paste this onto your cardboard base.
   b. Now cut out between the -4 and -5 levels and you should be left with a thin strip that can be used as a template for the -5 m level. Use it to shape another piece of cardboard that can be glued onto the base.
   c. Continue to build your model. Note that there are pools that are set into the 0 m mark.
   d. Use colours to show the different levels of the coral island.
   e. When you have finished, clearly label the model and hand it in for marking.

Questions

Read pages 514 to 517 of your textbook in conjunction with the model you have just made, to answer the following questions:

1. Why is the windward side reef slope steeper than the leeward side?
2. Why do bommies, caves and gutters occur on the leeward side?
3. Why is the coral island at the northern part of the model?
4. How deep is the lagoon?
5. Could you drive a boat to the island at low tide?
6. A boat with a draft of 1.2 metres wishes to drop a camping party of 50 Marine Studies students with their equipment for a weeks camping on the beach. The island in question is shown in Figure 40, page 517 of your textbook.

   What tides are necessary for this to occur assuming the loading time is 2 hours?

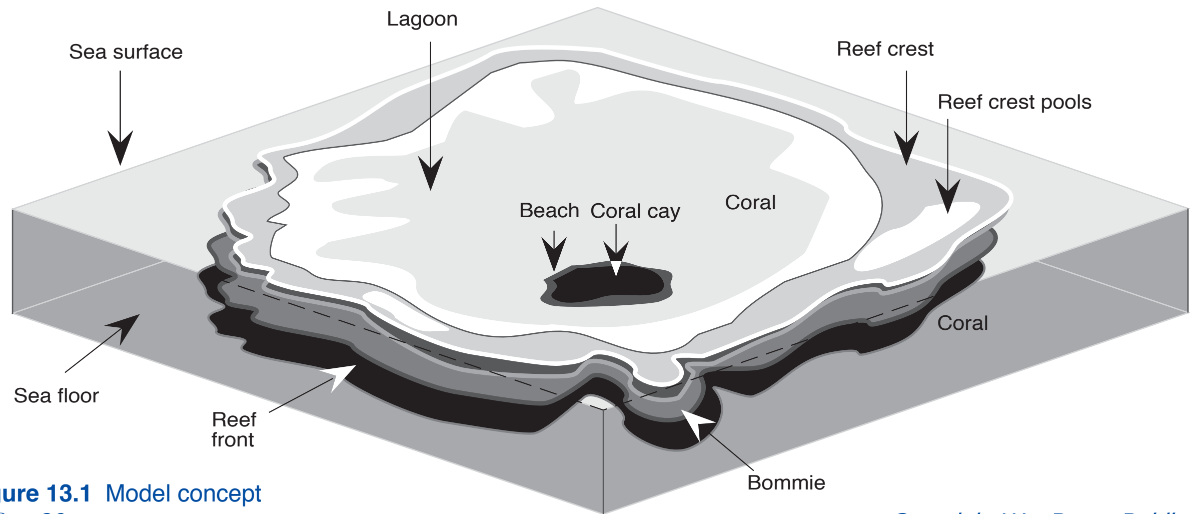


Figure 13.1 Model concept

Figure 13.2 Students may make one copy of this page so that they can attach their answers before handing in for marking.

EXERCISE 14 BEACH FORMATION AND EROSION PROCESSES

METHOD

Part A

1. Collect the materials for a wave tray experiment.
2. Make a beach with an offshore gutter and sand bank as shown in Figures 14.1 and 14.3A.
3. Generate very small rapid waves so that they pass just over the offshore sandbank as shown in Figure 14.3B.
4. Observe what happens to the sand on the bank and record the direction it moves.

Part B

1. Reconstruct your beach as shown in Figure 14.2.
2. Generate larger waves and observe what happens to the sand on the beach. Record your observations.

QUESTIONS

Turn to page 333 of your textbook and answer the following questions.

1. What is a wave bore? Draw a diagram to illustrate you understand what happens when small waves with small orbit fields pass over an offshore sandbank.
2. What is a microridge and what does it contain?
3. Define the term swash zone.
4. Draw a diagram of beach building conditions showing strong winds, primary and secondary dunes.
5. What important role do the trees in the secondary dune play?
6. What is an accreting beach?
7. What happens when large waves approach an accreting beach system?
8. What happens to the sand and what is formed on the beach?
9. In your textbook locate any six signs that indicate a beach is eroding.
10. Summarise the four sentences on beach erosion as outlined in your textbook and conclude with a paragraph on how sand returns to the beach.

MATERIALS AND EQUIPMENT (PER GROUP)

Equipment required

- white tote tray (tidy box)
- sand
- water and jug
- wave generator (a block of wood the width of the tote tray)

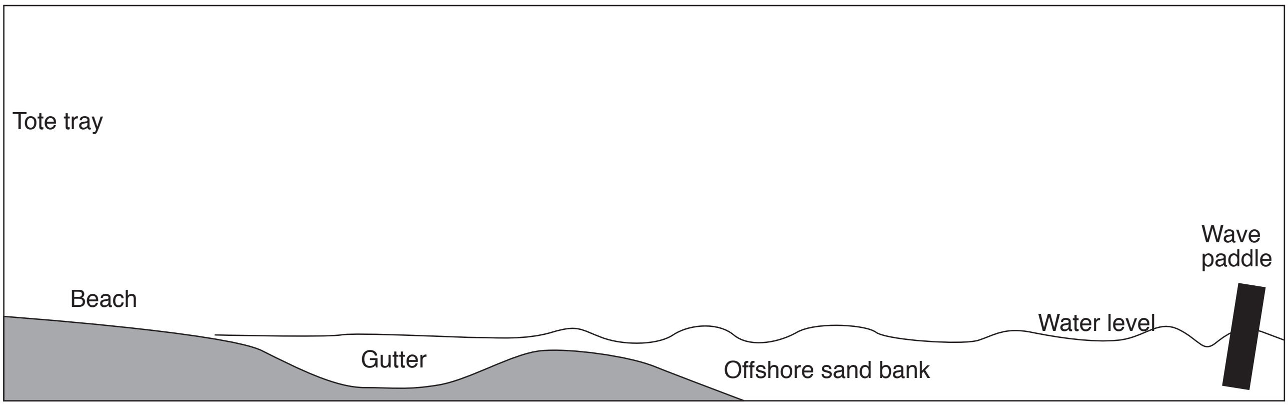


Figure 14.1 Setup for Part A: Wave tray arrangement for constructive waves

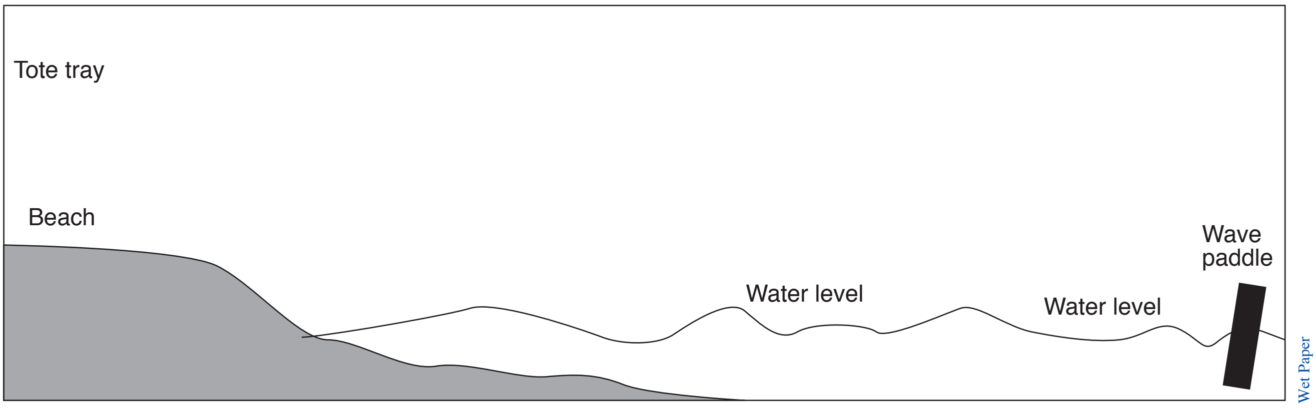


Figure 14.2 Setup for Part B: Wave tray arrangement for destructive waves

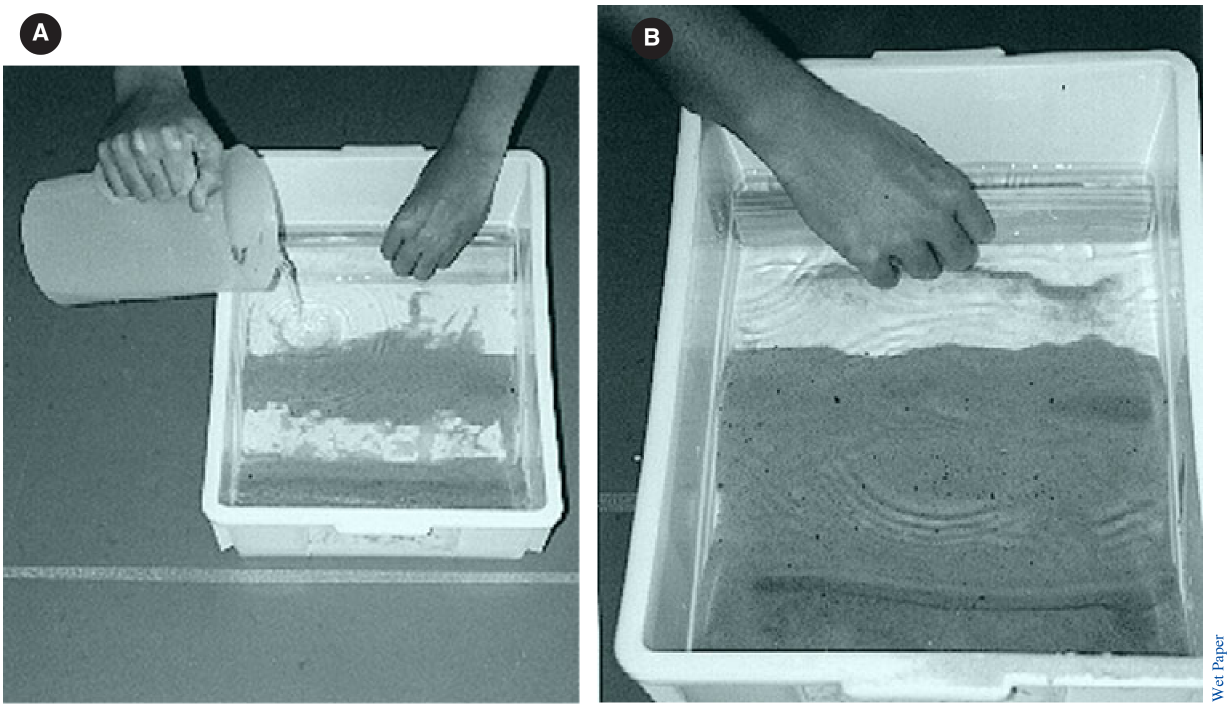


Figure 14.3 How to study the effect of waves on an offshore storm bar

Exercise 15
Orbit fields

Method

1. Ask your friendly Manual Arts Teacher to help you build your wave tank out of scrap wood, fibre glass and plastic as shown in Figures 15.1, 15.3 and 15.5. The windscreen wiper motor gives a good constant period to create the waves necessary for the experiments. Once the motor is screwed in place and working at about 6 volts, add sand and water.
2. You could build one using plastic, timber and have a manual paddle or you could even use a stream tray supplied to schools to show how streams flow. However, these have limited use as you need a side-on view.
3. Set the wave tank in operation to give slow small waves.
4. With a ruler, measure the wave length by working with a partner and, using a marking pen, mark off accurately two crests on the front of the tank.
5. Count the number of crests that pass a fixed point in 10 or 20 seconds and calculate the frequency in waves per second.
6. Now calculate the wave celerity using the formula as outlined in your textbook on page 328.
7. Fill the tank with sand to make a beach, gutter and offshore storm bar as shown in Figure 15.1. The distance between the top of the storm bar and the water level in the tank is critical. Some experimentation may be needed to move the sand forward, but should lie between the 20 - 50 mm range.
8. Start the wave paddle to create the effect as shown in Figure 15.2. Make a careful analysis of how the sand moves. As the waves move towards the beach the orbit fields start to interact with the sand and shape it into a beach profile .

Materials and equipment (per group)

Equipment required

- wave tank (see Figures 15.1, 15.3 and 15.5)
- 12V battery charger
- old windscreen wiper motor
- friendly Manual Arts Teacher or parent
- a copy of *Coastal Studies* textbook, Wet Paper Publications

  14 Milbong Tce Ashmore 4214

Questions

1. Are the wavelengths different for the different paddle speeds?
2. Does the frequency increase or decrease with wavelength?
3. How does celerity compare with wavelength? Is there any relationship?
4. If the wave tank is run for any length of time, does the sand at the bottom of the tank move? If so, in which direction and under what wave conditions?
5. Can you derive a formula for the conditions under which waves break. See Page 19, Figure 1.20 of the book *Coastal Studies.*
6. Can you suggest who might use such calculations and for what purpose?

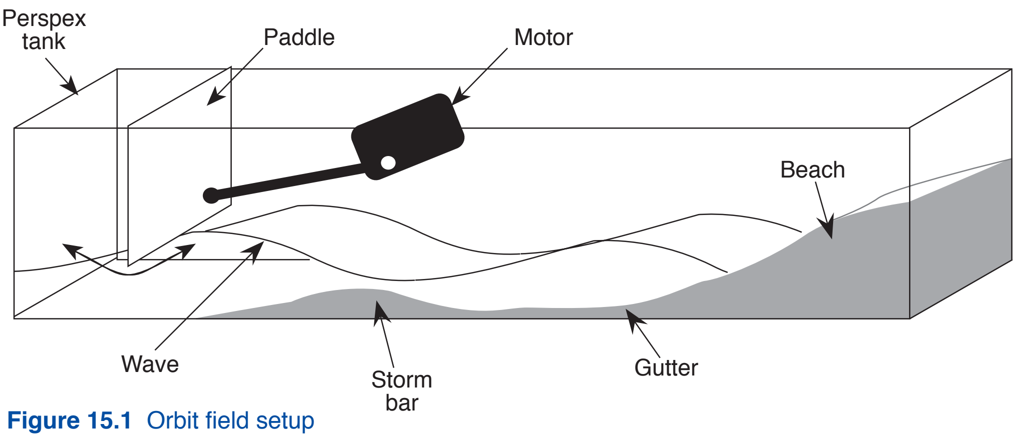


Figure 15.1 Orbit field setup
Wet Paper

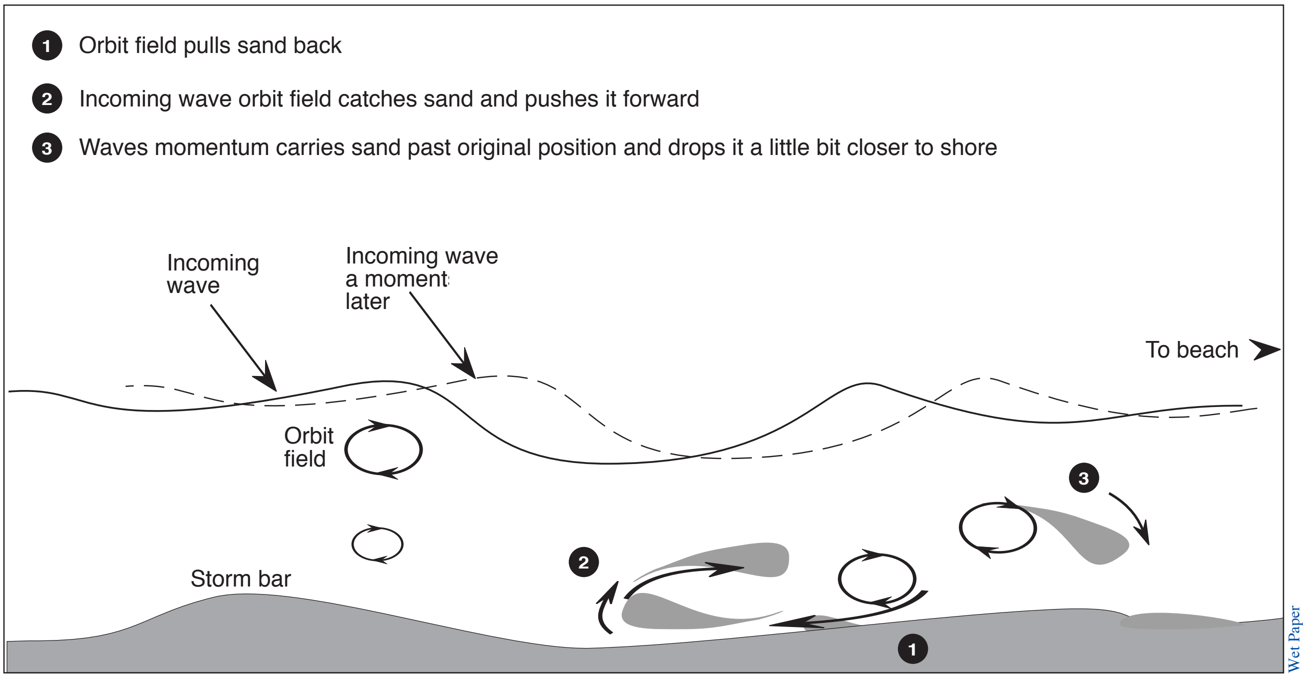


Figure 15.2 As small frequent waves move towards the beach, the orbit fields interact with the storm bar moving the sand slowly towards the shore

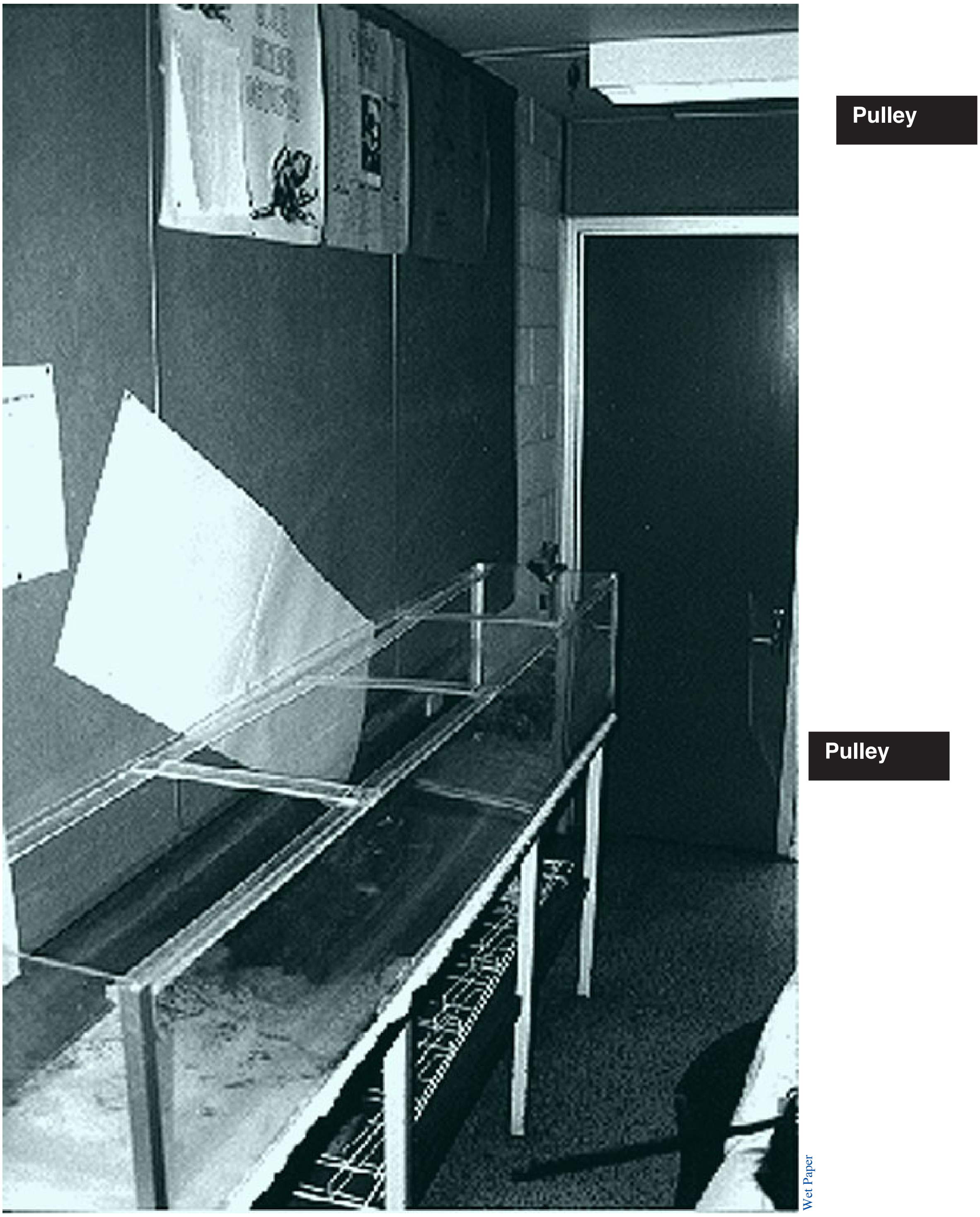


Figure 15.3 Wave tank at Pioneer SHS (Thanks to Greg McGarvie and Nick Morrow for assistance in organising this photo)

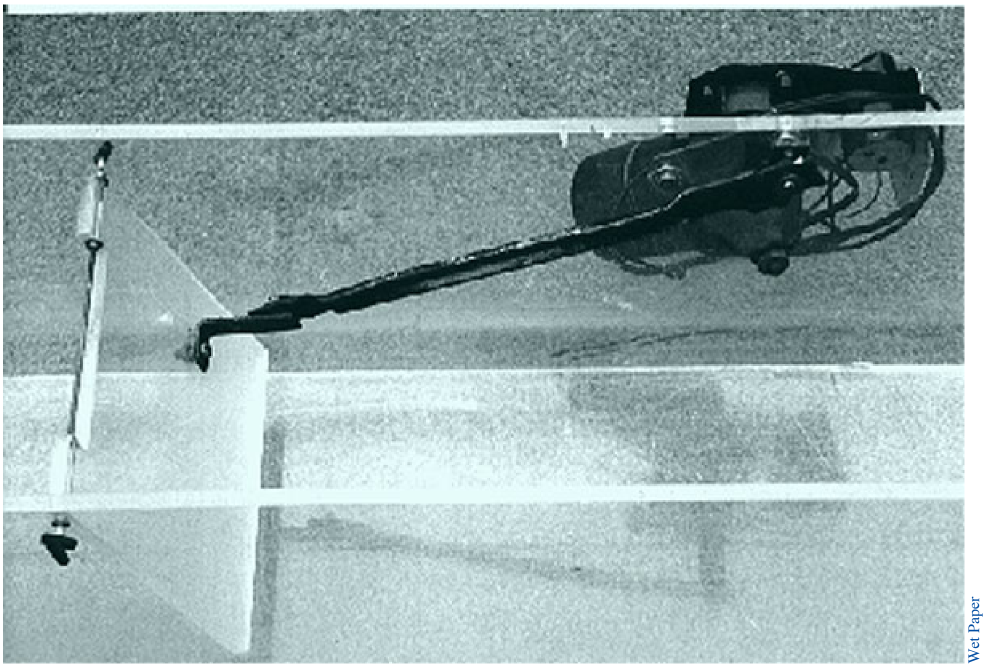


Figure 15.4 Close up of wave paddle setup

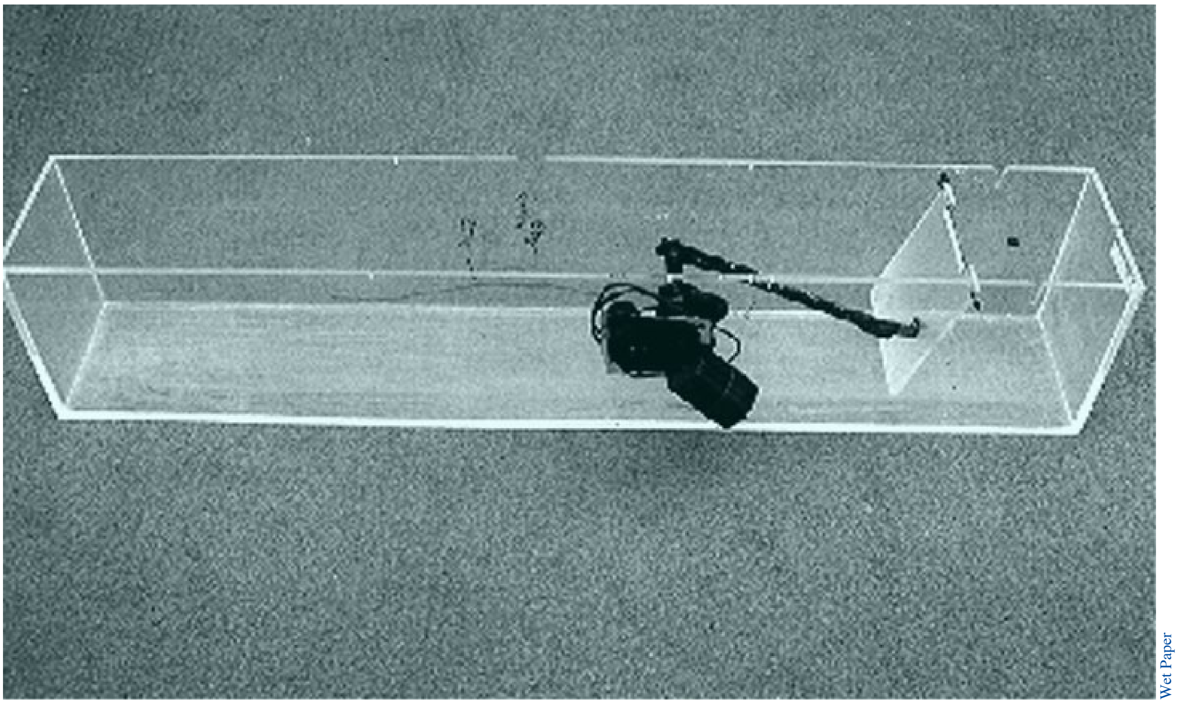


Figure 15.5 The original Wet Paper wave tank (you may alter it as you like, just acknowledge the source)

Exercise 16 Sand per cent composition

Method

1. Take an empty pie dish or plastic jar and weigh it on the balance supplied.
2. Collect the sample bottle and three quarters fill it with a sample of sand. This is called a sub-sample.
3. Place on a balance and weigh it to the nearest 0.1 g. Record the weight in your notebook.
4. Arrange the sieves into a nest so that when you shake your sand through it won't be spilt.

   The sieves should be arranged in order 300 µm, 250 µm, 200 µm and the ice cream container.
5. Now carefully pour the sand into the top sieve. Shake gently for at least 30 seconds to give the sand a chance to move through.

   Be careful not to spill the sand.

Materials and equipment (per group)

Equipment required

- lab balance
- 4 aluminium pie dishes or plastic jars as shown in Figure 16.1

For beaches with fine sand grains

- sieves of sizes, 300 µ metres, 250 µ metres, 200µ metres

For beaches with larger grain sizes

- sieves of sizes, 600 µ metres, 400 µ metres, 200µ metres
- aluminium pie dishes labelled as follows:
  - subsample, >300 µm, 250 µm, 200 µm, < 200 µm
- 2 ice cream containers
- completely dry sand samples from top, middle and bottom of beach in plastic zip top bags

6. Fill each of the labelled sample bottles or pie dishes with the correct sample from each sieve.

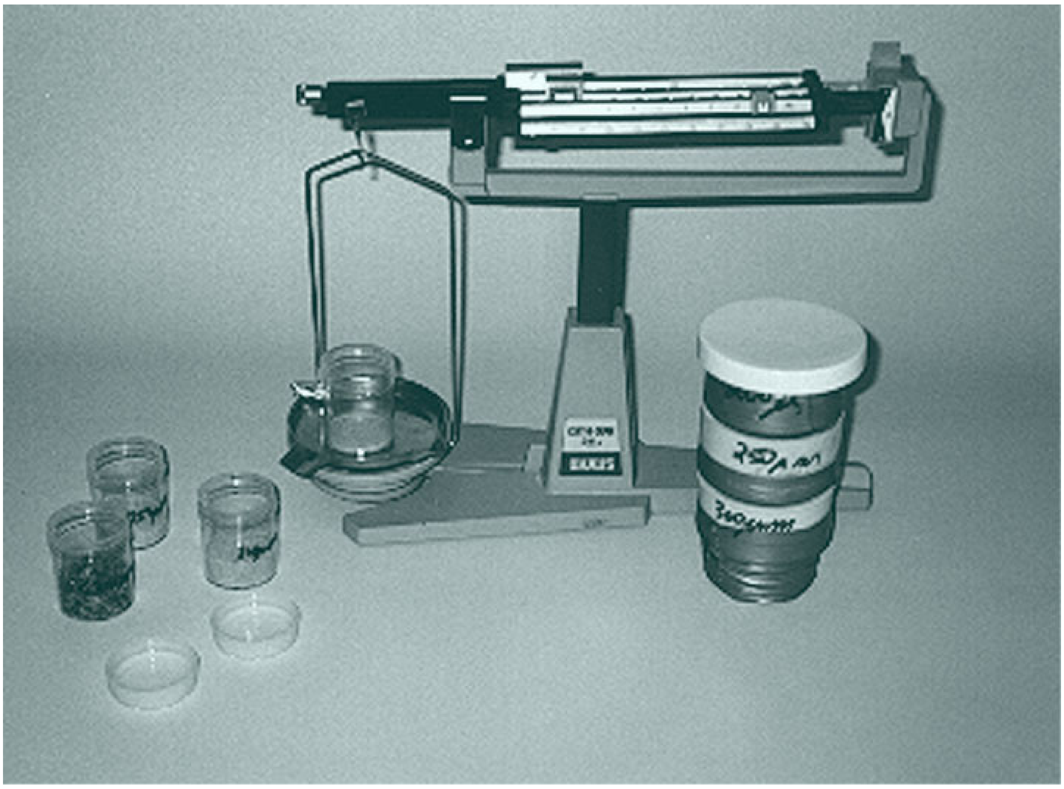
   Use a second ice cream container to remove any trapped sand.
7. Weigh each of the sieved samples and record their weights in Figure 16.7.
8. Calculate the weight of each sand fraction and the % composition.
9. Transfer this to the data summary table.
10. Empty out the sand samples and clean the insides.
11 Repeat for the other sand locations and complete Figure 16.7.
12. Draw a graph of particle size percent composition versus site on beach marking clearly top and bottom of beach.

Questions

Sand is composed of different grain sizes with the greatest percentage of large grain sizes at the bottom of the beach.

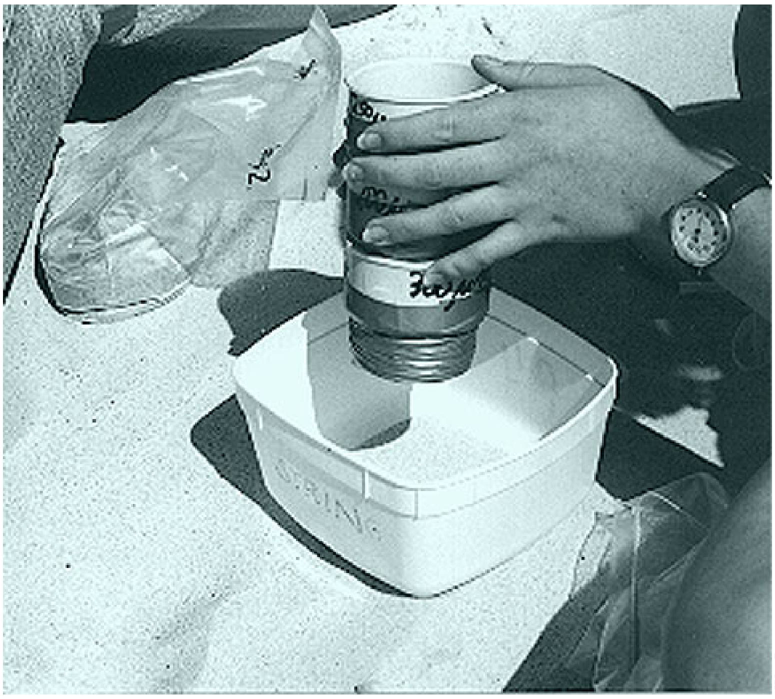
Your sieve sizes have to match the range of grain sizes you are working with. Coral Islands will have different sieves for coastal beaches with low wave action.

1. Where was the greatest percentage of larger sand grains on your beach?
2. Is this consistent with the statement at the beginning of this section? Account for any differences.
3. Why are smaller grain sizes found at the top of the beach?
4. Which type of vegetation is responsible for capturing this type of sand grain?
5. Why are dunes fenced and covered with cloth as part of dune management practices?
6. The next activity allows you to collect information on beach profiles. Turn to page 321 of your textbook and answer the following questions:
   a. Do you think that there would be any relationship between beach profiles and size of sand grains?
   b. Which beaches have muddy shores?
   c. Which beaches have sandy shores?
   d. Look back to Exercise 12 and describe places where sandy shores would occur in Hypothetical Bay.



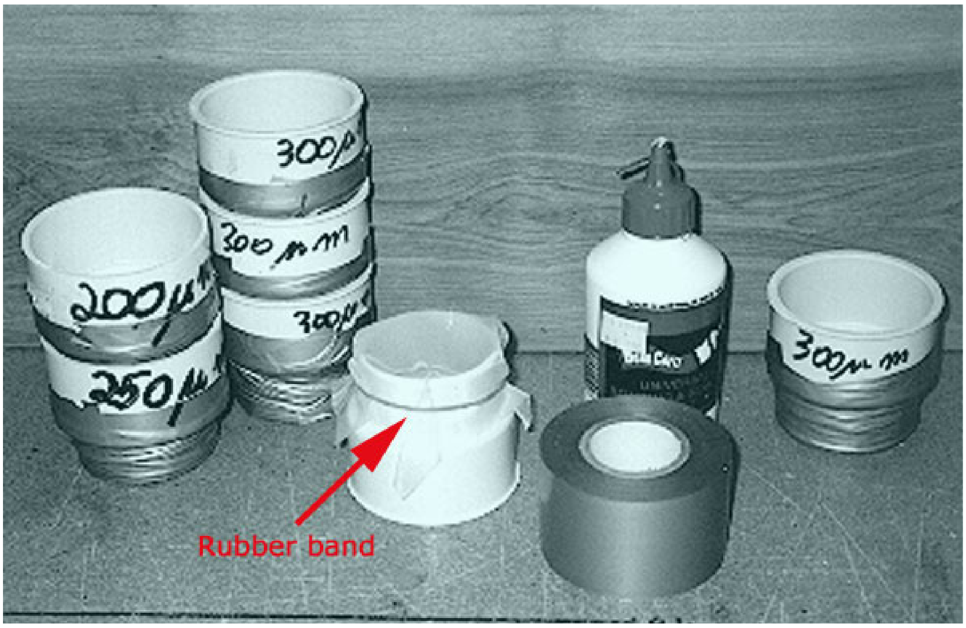
Wet Paper

Figure 16.1 Laboratory setup to measure percent sand composition



Wet Paper

Figure 16.2 Use the sieves to separate the different types of sand grains



Wet Paper

Figure 16.3 Materials necessary to make sieves

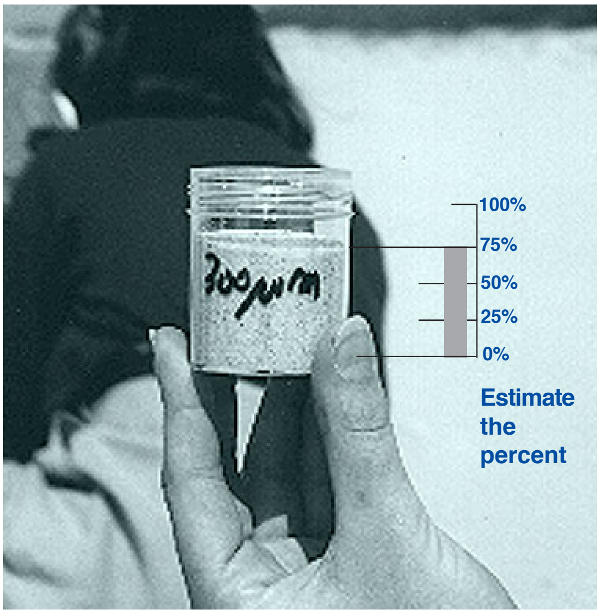
To make sieves

1. Mesh of very fine mesh sizes is available from Swiss Screens, Randall St, Slacks Creek, Q'ld, 4127.
2. Plastic sieves as shown in Figure 16.3 are available from Hardie Iplex, in a trades pack of 10, and are called a weathering apron, 50mm, product code is VO 7450.
3. The silk comes in widths ranging from 900 - 1200mm and a 125mm long strip will make 9 sieves of the sizes mentioned above. If you use the 50mm weathering apron, then cut the 125mm strip into nine equal squares.
4. Use a rubber band as shown in Figure 16.3 to hold down the mesh and then add bondcrete glue around the rubber band.

   Take the all weathering tape and bind the mesh to the sieve. Pull down the tape as you bind to make a strong seal. Allow to dry for 24 hours.
5. Make sure you mark the sieve with the correct size.

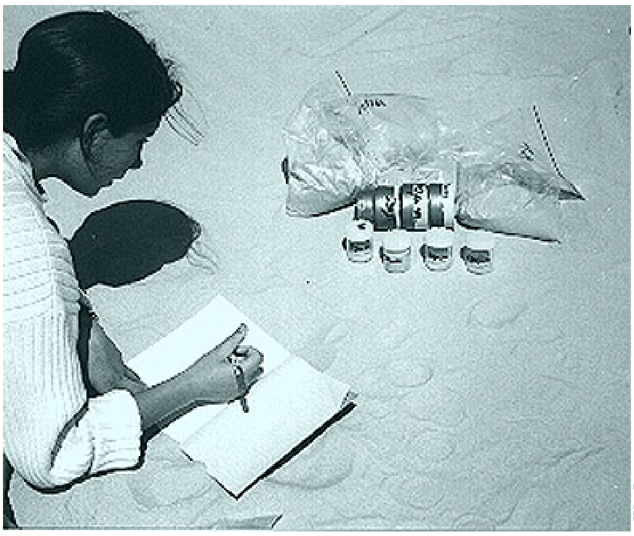
Field work hints

1. Often it is impractical to take a balance into the field. In this case the use of small plastic containers as shown in Figure 16.4 may be of assistance.
2. You will need a labelled container for each sieve as shown in Figure 16.4.
3. Use a rough estimation as shown in Figure 16.4 to work out the percent.
4. Use zip-top plastic bags to collect other sand samples that can be taken back to the lab and analysed if time permits.



Wet Paper

Figure 16.4 Estimating percentage



Wet Paper

Figure 16.5 Comparing the different sieved samples

Figure 16.6 For sand from coarse grained areas, a larger sieve needs to be used. (Photograph Geoff Jensen)

Site

Bottle type	Bottle weight empty	Bottle weight with sample	Weight of sample	Fraction of total weight	% of total weight
Collection bottle					
300 μ m					
250 μ m					
200 μ m					
< 200 μ m					
Error					

Figure 16.7 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 17
Beach profiles

Method

1. Make a profile metre rule like the one shown in Figure 17.1 and practice on a slope at school to record the change in heights down a slope or bank.
2. Start at the top of the bank — call this your datum point.
3. Position the metre rule so that it becomes level as shown in Figure 17.2.

   Pull the tape down to the ground and take a firm grip of the tape at the point it touches the sand.

   Then, without altering your grip, bring the tape up so that you can measure the distance from the end of the ruler and the point the tape touched the sand.
4. This distance represents the fall over one metre.
5. Record this in Figure 17.3.
6. Place a stick or pencil at the place where your hand touched the sand and move the metre ruler to begin the next reading.
7. Repeat this procedure as you go down each metre of the beach and gradually fill up Figure 17.3. Use another sheet if you have a long beach.

   Record ups as + and downs as –, noting distinguishing features on the beach such as dominant plants, grazing by animals, droppings, fences, walkways, erosion scarps, low or high tide marks, areas of microridges, sand waves, moving sand particles.
8. When you get to the swash zone (that's the area where water runs up the beach), measure it.
9. Back in class or at home, recalculate all your measurements so that you can see how far each station is below the datum point. Now plot a profile of the beach slope.

Materials and equipment (per group)

Equipment required

- note pad and pencil
- metre profile rule
- camera (optional)
- protractor

10. If you have a camera, take photographs of dominant dune plants and significant changes to beach profile. Look for human impact and make a note of these.
11. When you have assembled all your data from Figure 17.3, use the graph supplied in Figure 17.4 to draw a graph of distance from beach datum to low tide versus height below datum.

    Use the information you collected to indicate where plants were found.

    Identify the primary and secondary dunes from your graph and indicate where you think these are on the beach.

    Indicate also any other developments you can identify from your photographs or notes.

Questions

1. Is there any evidence of beach erosion? How can you tell from your graph?
2. How wide was the swash zone? How will this change over time?
3. Make a prediction of how this profile will change over the year.
4. Work out the profile angle and compare it with others in your class. Are they all the same?

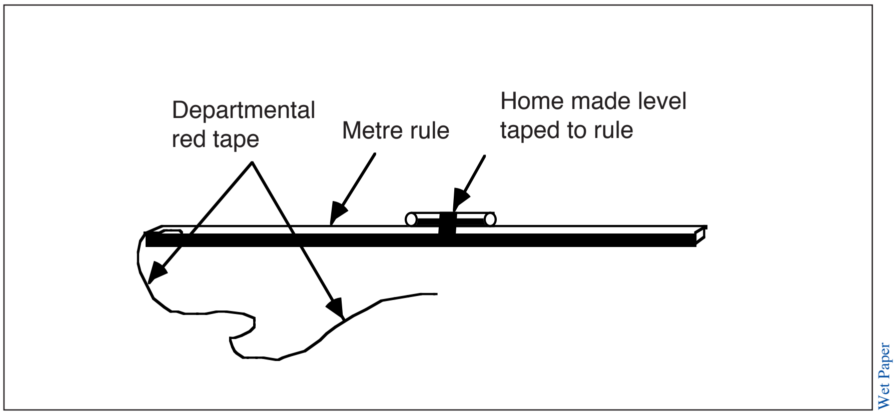


Figure 17.1 A profile metre rule (Thanks Ann Coopersmith, UNESCO)

Figure 17.2 Students measuring a beach profile

Your observations

Distance out from datum (metres)	Fall or rise in m/cm from datum	Notes, e.g. dominant dune plant, erosion scarp, microridges start, low tide mark, fence line
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		

Your observations

Distance out from datum (metres)	Fall or rise in m/cm from datum	Notes, e.g. dominant dune plant, erosion scarp, microridges start, low tide mark, fence line
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		
63		
64		
65		
66		
67		
68		
69		
70		

Figure 18.3 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Graph of distance from beach datum to low tide versus height below datum

Wet Paper

Figure 18.4 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 18
The Active Beach System

Based on an original exercise by Gwen Connolly, St. Augustine's College

Method

1. Read the instructions to the three level guide in Figure 18.1.
2. Now read the article in Figure 18.2 then complete the following:

Level 1 Literal — reading for accuracy

a. For each of the following statements write T (true) or F (false) in the space just after the number.

b. Be able to show where these statements appear in the article.

c. Use P for paragraph and L for line.

1. ____ Beaches are made of sand from the erosion of rocks.
2. ____ A sand budget is only governed by the prevailing winds, tides and currents.
3. ____ Small broken waves predominately control the sand build up on the beach.
4. ____ Bores drop their sand in a small ridge known as a berm.
5. ____ During storms, wave bores, drag the sand offshore to form a sand bar.
6. ____ A groyne is a preventative measure against weathering.

Level 2 Interpretive — drawing conclusions

1. ____ Estuaries and bays act as sinks where sand is stored for later movement along the beach.
2. ____ Bays are areas of sand collection due to the bending of waves around headlands.
3. ____ A beach will not erode during a storm if the waves are absorbed by the storm bar.

Level 3 Applied — defending your opinion

Be able to give reasons (argue) why your answer is correct.

You may draw on additional information from other sources.

1. ____ Beach conservation groups should be more active in your local area.
2. ____ Developers should be allowed to build on the waterfront.

The three level guide

A three level guide is used to impart important information. Teachers believe that in doing work and having to justify your answer, students are more likely to remember it.

The following rules are important to make this work.

1. Absolute silence for 10 – 15 minutes during which time you are to read the article and answer True (T) or False (F) to the statements in the method section.

   You also need to justify your answer by referring to the article, e.g. P3L2 — paragraph 3 line 2 or F10.2 — Figure 18.2.

2. The class is then divided up into groups of four students and you have 15 minutes to discuss your answers and arrive at a group set of answers. Make sure that democratic discussion occurs and that the group is not dominated by one or two people.

3. Finally, re-group and as a class discuss the article.

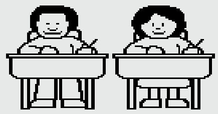


Figure 18.1 The three level guide

Students may make one copy of this page so that they can attach their answers before handing in for marking.

Beach composition

Beaches are made of sand. The sand comes from the erosion of rocks and has been washed down to the sea over many years to form the sand budget.

The sand budget moves in a sand system which is governed by the shape of the coastline, prevailing winds, tides and currents.

Sand is added to the system at one end, creeps along the coastline and is lost at the other. Estuaries and bays can act as sinks or places where the sand is lost. Moreton Bay in Queensland is a sink which absorbs the sand as it flows north.

Beach building

Small waves are the predominant force that controls the sand buildup on the beach. As a small wave breaks, it forces the sand up off the sea-bed. The broken wave is called a wave bore as shown in Figure A.

This bore carries the sand towards the beach. There are many bores at a time and the net movement is towards the beach.

When the bore stops it loses its energy and drops this sand in a micro-ridge that can be seen on the beach. Some sand runs back, but more bores overtake the sand moving back with the net result of sand staying in the swash zone.

As the tide goes out these microridges dry and wind blows the sand up the beach into the dunes.

Sand also moves along the coast in a longshore drift current. The current moves the sand because the waves break on the beach at an angle. Where headlands occur, waves bend around and slow down dropping their sand.

Beach erosion and rebuilding

Larger waves formed during storms break down the beach as shown in Figure B below. Initially they erode the beach face dragging sand out to sea. The wave bores are very long and drag the sand offshore to a storm bar. The sand runs back forming runnels. There are not enough wave bores to keep the sand there.

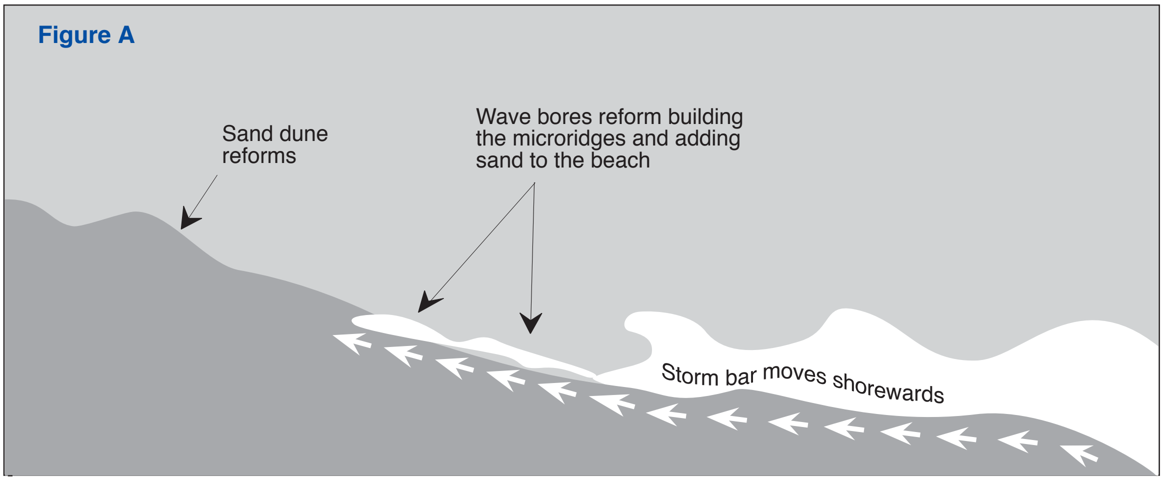
The beach keeps eroding till the forces of the storm waves can be absorbed on the storm bar.

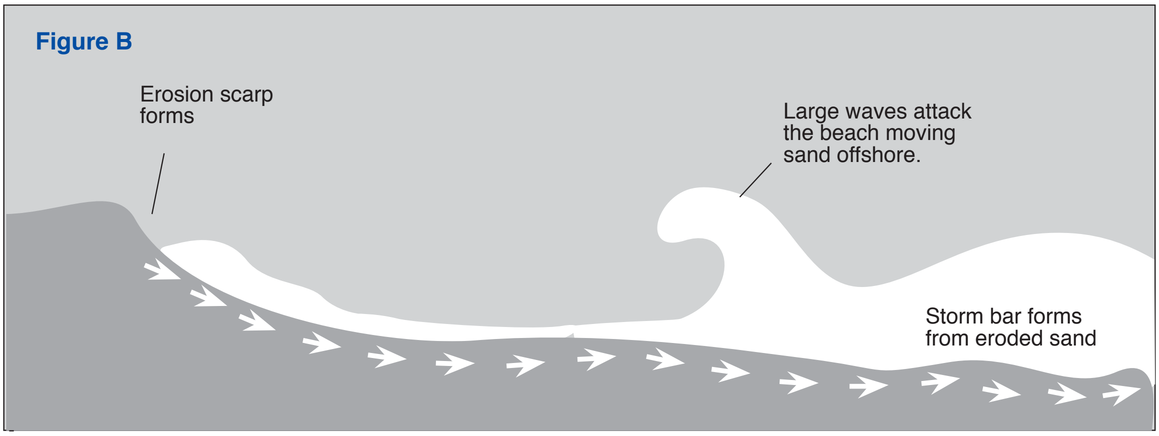
When the waves get smaller, the sand moves towards the beach again pushed by the wave bores.

Beach conservation

Some preventative measures have been offshore breakwaters, rock boulder walls, groynes, dumping sand on the beach by trucks or pumping it from offshore (or creeks and rivers). Dune fencing and the planting of beach trees and shrubs have also been part of prevention programs. These measures are all designed to maintain beach levels.

Beach conservation involves the establishment of a program (often long term) that will allow natural movement of sand while maintaining the natural sand budget. It is necessary for tourism, but also needs to provide aspects of the natural world which are necessary to maintain nature's balance. Conservation intends to maintain a balance in nature in terms of human habitation, e.g. protection of beach front sand, maintaining beaches for locals and tourists.





Wet Paper

Figure 18.2 Beaches article

EXERCISE 19
BEACH EROSION MIND MAPPING

MATERIALS

- copy of video GCCC Sand nourishment to the rescue

  Griffith University
  U tube

Acknowledgement is made to Gwen Connolly for the outline of this activity.

METHOD

1. Watch the video once.
2. Watch it a second time, and then answer the questions in Figures 19.1 and 19.2.
3. For homework, write a paragraph outlining the problem experienced by the Gold Coast and what solutions can be used to overcome the problem.

1. Gold Coast is an invaluable asset. Give three reasons in the space below.

   a. ____

   b. ____

   c. ____

2. It has the greatest development pressures in Australia.

   Therefore [____________] and [____________] are needed.

3. Nature protects the beach in a storm.

   Nature does this by using a [____________] bar. —reduces→ [energy]

4. After the storm when wave size is reduced

   Sand moves [____________] onto the beach. —caused by→ [waves]

5. In 1962 the NSW Government extended the rock training walls at the mouth of the Tweed River.

   Causing - [Interference with]

   ↓

   [Trapping of]

   ↓

   [Starvation of sand to offshore shoals]

   Then in 1967 a series of ________ cyclones - → [ ]

   ↓

   [Causing -]

Figure 19.1 Worksheet A

5. What was done about the problem?

a. The Delft report made three recomendations. →

b. Funding? →

6. 1972 - Another cyclone caused →

building of

1974 - Another cyclone caused →

boulder wall at Kirra

to prevent ↓ the

7. Finally the government woke up to the extent of the problem and

a. gave

b. established a

8. 1983 - Government realised that sand replenishmnet by itself was not enough and that other ways were needed such as

a. Dune

b. Establishment of training walls protects →

c. Establishment of a sand by-pass system

to prevent →

d. Dredging to replenish the

and to restore the

e. Boardwalks

which could

f. Boulder walls which

paid for by the

g. More work is however needed

to stop the

Figure 19.2 Worksheet B

Exercise 20 DDT in the Food Chain

Based on an original exercise by Tim Ryan, Maryborough State High School.

Questions

Read the article in Figure 20.1 and answer the questions below.

1. Why do you think scientists describing the problems of DDT talk about the poison pyramid?
2. Insects eventually became resistant to DDT even when the original recorded kills were 99%. Explain how this could have happened?
3. How was it possible for DDT to save over millions of lives in malaria affected countries? How could DDT affect the transfer of infectious diseases?
4. Why are some of the effects of DDT on human population not yet known? Why has it taken so long to find out?
5. By how much does the concentration of DDT increase as you move up the food chain?
6. How could we control insect pests if we are not to use chlorinated hydrocarbons?
7. Another chlorinated hydrocarbon in the news lately is Dieldrin. Where has this chemical been a problem?
8. What steps must be taken if history is not to repeat itself with the introduction of new and different insecticides?
9. What were the advantages of DDT? What other types of insecticides have been developed?
10. Who should pay for the cost of cleaning up the DDT mess?
11. The amount of chemicals that is poured into the oceans is unbelievable. It has been estimated that for the last 25 years 1,400,000 tonnes of DDT eventually found its way into the sea.

    How much DDT would now be in the sea?

DDT in the food chain

After the Second World War the scientists began to develop synthetic chemical pesticides.

They developed the chlorinated hydrocarbon insecticides, of which DDT is the best known. DDT was developed by the Swiss scientist, Paul Muller, and it earnt him a Nobel Prize in 1948.

DDT was extensively used in agriculture in the 1950's and 1960's to control all kinds of insect pests and allow huge increases in food production.

It was believed that DDT had no effect on other animals.

DDT saved millions of lives in malaria affected countries. Unfortunately, the full effects of DDT on the environment and animals were not noted until the late 1960's.

DDT is nonbiodegradable and is strongly resistant to chemical action and does not dissolve in water.

When an animal eats another animal containing DDT, most of this DDT is absorbed and dissolves in the fatty tissue where it remains until it dies.

Therefore once DDT is sprayed on crops it will eventually be washed into the rivers and creeks. Here it will then find its way into aquatic plants and phytoplankton.

The concentration in these plants is mostly very small and does not affect them.

High concentrations affect their ability to photosynthesis and may stunt their growth.

The animals which eat these plants accumulate DDT in their bodies as shown on the following table.

Source	DDT Concentration in parts per million
bottom sediment	0.00006
phytoplankton	0.06
zooplankton	0.4
predatory fish	8
predatory birds	240

DDT has a serious effect on these animals. It can cause:

a. some birds to become sterile

b. the egg shells to become thin and easily broken

c. the embryo's growth to slow down

d. the production of sex hormones to stop

DDT can also build up in the human population. Mother's milk has been shown to contain more than 4 times the accepted level for fresh milk in some communities. DDT can also cause liver damage, stunted growth and nervous problems.

Figure 20.1 Potential for pollution of the coastal zone

Exercise 21 Management of Longshore Drift

Based on an original exercise by Gwen Connolly, St. Augustine's College

Method

Read the instructions to the three level guide in Figure 18.1. in Exercise 18. Now read the article in Figure 21.1 and complete the following:

Level 1 Literal — reading for accuracy

a. For each of the following statements write T (true) or F (false) in the space just after the number.

b. Be able to show where these statements appear in the article.

c. Use P for paragraph and L for line.

1. ___ The Nerang River used to enter the sea much further south of its present location.
2. ___ The Southport Yacht Club frequently hosts open sea races.
3. ___ The Federal government decided to 'train' the river entrance by the use of rock walls.
4. ___ The northerly movement of sand gets trapped by the seaway wall.
5. ___ The sand bypass system collects sand and pumps it under high pressure under the seaway.
6. ___ Wavebreak island was established to trap sand that leaves the river and to stop waves from reaching the foreshore.
7. ___ By sand bypassing, no delta is formed at the river mouth.

Level 2 Interpretive — drawing conclusions

Be able to show why you arrived at the following conclusions with evidence from the article.

1. ___ The establishment of the Gold Coast Seaway has prevented loss of life and vessels.
2. ___ Sand no longer gets trapped on the southern side of the seaway.
3. ___ Other problems have been created by the construction of the seaway.
4. ___ Animals and plants suffer when sand bypassing is used.

Level 3 Applied — defending your opinion

Be able to give reasons (argue) why your answer is correct. You may draw on additional information from other sources to justify your answer.

1. ___ Construction of a seaway is a necessary evil.
2. ___ Conservation groups should be advised when planning to build a seaway.

Case study

The Nerang River in Queensland lies at the northern end of the Gold Coast. Over the years, the river entered the sea much further south and progressively moved northwards from the late 1900's. This is a feature of river systems which are affected by a northerly movement of sand.

The bar at Southport has become dangerous for boats and trawlers. The Southport Yacht Club had never had an open sea race because they could not get their boats out. Many accidents were occurring on the bar with loss of life and valuable investments. The local government in association with state and other consultancy authorities decided to 'train' the river entrance by the use of rock walls. It was realised that a system of sand bypassing had to occur so that the natural northerly flow of sand would not block the river mouth and prevent the other beaches north of the wall from eroding.

What was called for was a system which could take the sand from one side of the training walls to the other without forming a delta. This system is called a sand bypass system because it bypasses the river mouth. The one built at the Nerang River mouth takes the sand from one side to the other before it has time to build a delta. Sand therefore cannot enter the river and silt the mouth. Boats can keep using the seaway in all weather and the sand can continue north thus stopping erosion on the other side.

Since the establishment of the bypass system in 1986, considerable sand has been pumped northwards. Problems have been in the jet pumps because sand is a very abrasive mixture. Wave Break Island has developed into a fully vegetated sand island with casuarinas and sand spinnifex in abundance.

The river mouth has become deeper and the tide levels have changed in the river. More sand is exposed during low tide creating problems with breeding grounds for animals and plants. Currents have increased at the river mouth and more people enter and leave the bar adding to the local rescue problems. On the whole the seaway has been a success and will be closely watched as a fore-runner to other engineering feats.

The effect of this sand bypassing system is shown in Figures 21.1 and 21.2.

Figure 21.1 Students may make one copy of this page so that they can attach their answers before handing in for marking.

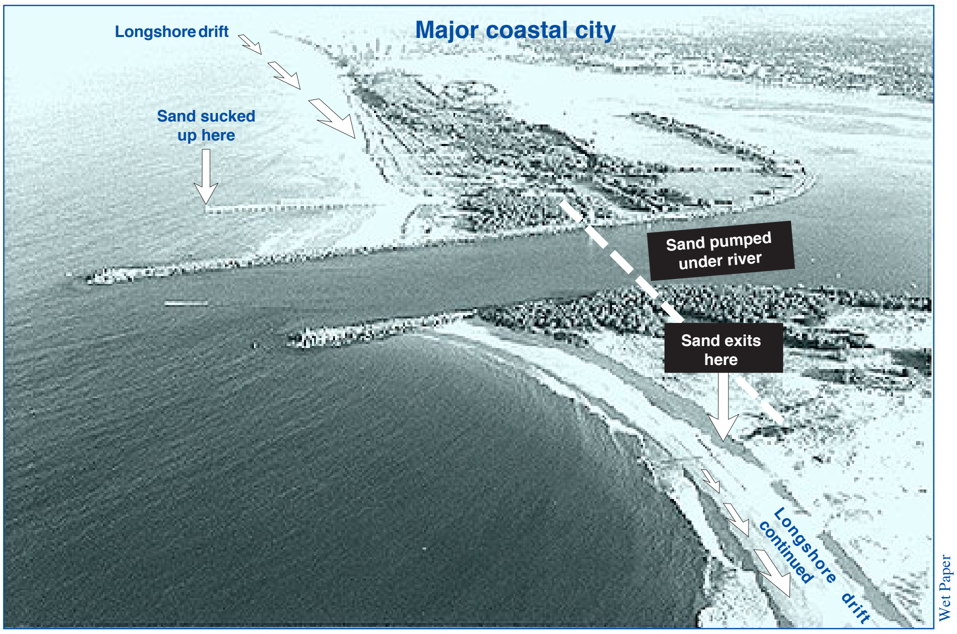


Figure 21.1 Longshore drift and the Nerang River entrance

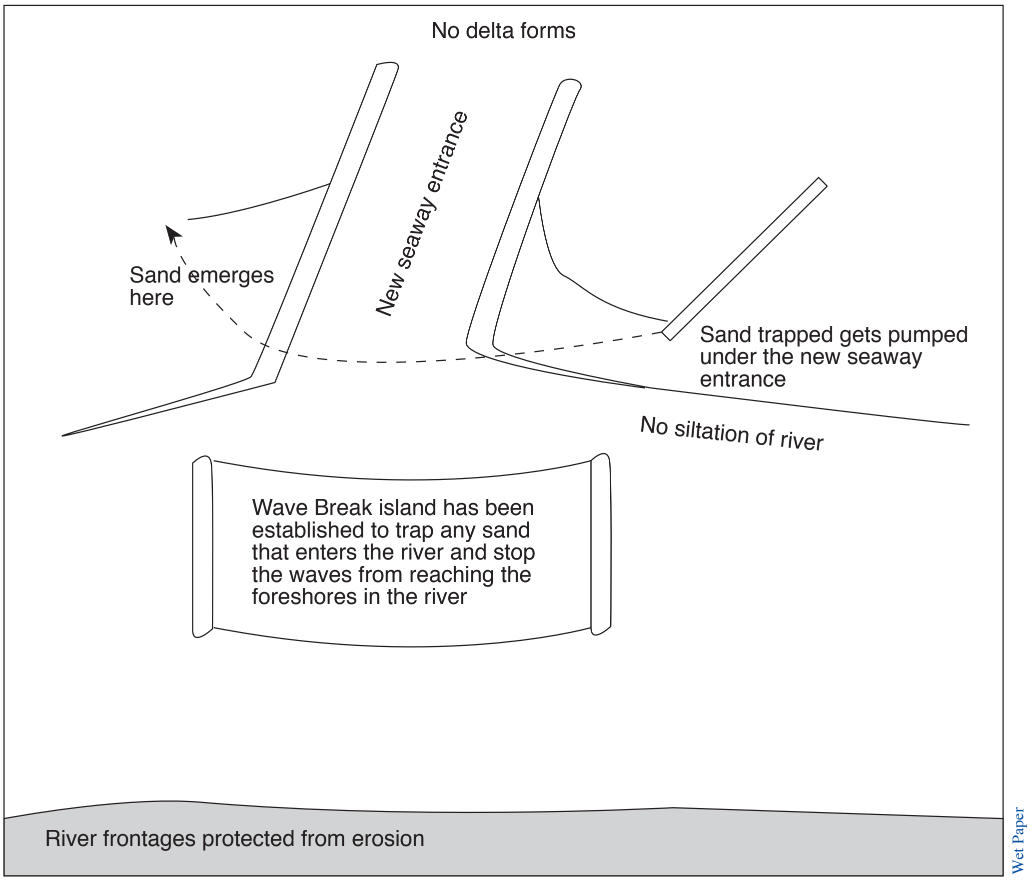


Figure 21.2 The sand bypassing system

Exercise 22
St. Vincent Gulf

Based on an original exercise by Tim Ryan, Maryborough State High School. Acknowledgement is given to the Australian Fisheries Management Authority for permission to reproduce the article from Australian Fisheries March 1986.

Questions

Read the articles in Figures 22.1 and 22.2 and answer the questions below.

1. Suggest eight sources of contamination in St. Vincent Gulf.
2. To determine an estimate of the trace elements in St. Vincent Gulf by water analysis was labour intensive and time consuming. Why was this so? How were the levels of contamination determined?
3. Name the types of organisms that were examined in this study.
4. Which metal trace elements were investigated?
5. What do the letters NHMRC stand for?
6. In which tissue of the fish were the highest levels of zinc? Suggest an explanation for the results.
7. What were the NHMRC recommended levels of:

   a. lead in fish

   b. zinc in molluscs

   c. copper in crustaceans
8. Did any of the levels of trace elements found in the examples exceed the maximum recommended concentrations of the NHMRC?
9. Calculate the weight of copper found in a sample of 3 kg (dry wet) of fish muscle.
10. Calculate the expected range of weight of zinc found in 10 kg of living mollusc muscle.
11. Compare the trace metal value found in St. Vincent Gulf with Cockburn Sound (WA). Determine if any of the levels at Cockburn Sound (WA) are above NHMRC recommended levels.

12 Would you expect trace metal levels to increase in organisms as you go up the food chain? Explain your answer. Did this occur at St. Vincent Gulf in all cases? If not, suggest a possible reason for this observation.

Little contamination of St Vincent Gulf, SA

The St Vincent Gulf marine ecosystem is subject to urban and industrial wastes from a major industrial centre - Adelaide. There is also some agricultural runoff. Such inputs are known to contain trace metals and are likely to lead to an increase in the concentrations of trace metals in the coastal zone, some of which are toxic and may endanger human health.

However, obtaining a realistic estimate of the level of trace metal contamination in the Gulf by water analysis is laborious and time consuming. Diffuse inputs and variable wind and current conditions make it necessary to analyse a large number of samples to obtain a reliable estimate of the extent of trace metal pollution.

Alternatively, the analysis of marine organisms provides a rapid and relatively inexpensive way of obtaining an estimate of trace metal contamination as marine organisms concentrate trace metals over a period of time, providing a time-averaged measurement of trace metal input.

A study has been undertaken to ascertain whether common species of molluscs, crustaceans, fish and marine plants contain concentrations of trace metals hazardous to public health and to establish the general level of trace metal pollution in the Gulf.

Molluscs, crustaceans and marine plants were collected from coastal areas south of Adelaide. A summary of the trace metal levels found in marine organisms is given in Figure 22.1. Fish species included *Silliaginodes punctatus; Arripus georgianus; Hyporhamphus australis* and *Platycephalus bassensis*. Molluscs included *Pecten alba; Sepioteuthis australis* and *Haliotis ruber*. The crustaceans analysed were *Panaeus latisuleatus* and *Portunus pelaguis* while four species of marine plants were analysed: *Posidenia australis; Posidonia sanuousa; Ecklonia radiata* and *Ulva sp*.

Results

All trace metals were well below the National Health and Medical Research Council (NHMRC) maximum recommended concentrations. Cadmium and lead concentrations, usually good indicators of anthropogenic inputs, were all low.

Although high concentrations of copper were found in some molluscs and crustaceans, molluscs and crustaceans can contain high copper concentrations under natural conditions due to storage of copper in proteins and the presence of haemoeyanin in blood.

Comparison of trace metal values with those measured in marine organisms from other areas of Australia known to be subject to urban and industrial influences (Figure 22.2) revealed that metal concentrations are low indicating little measurable metal pollution in St Vincent Gulf.

Article by Dr. W. Maher, lecturer at Canberra College of Advanced Education.

Trace metal concentrations in marine organisms from St Vincent Gulf, South Australia

	mg/Kg (dry wt)			
Fish	**Cadmium**	**Copper**	**Lead**	**Zinc**
muscle	<0.25	0.51-1.3	<.02-.05	15-55
liver	<0.25	0.70-6.0	<.02-.061	20-88
gills	<0.25	0.72-4.0	<.02-.096	50-110
n=28				
Molluscs				
muscle	<0.25-.51	0.81-24	0.52-0.96	36-60
viscera	<0.25-1.93	2.7-91	0.56-2.1	30-101
n=24				
Crustaceans				
muscle	0.11-0.5	5.7-15	0.31-0.71	16-36
viscera	0.1-2.1	24-28	1.3-1.4	55-58
n=11				
Seagrasses/macroalgae				
	0.1-.78	1.5-3.8	0.2-3.6	24-73
n=23				
NHMRC recommended levels*				
Fish	1	50	7.5	750
Crustaceans	0.25	50	7.5	750
Molluscs	10	350	12	5000
	(0.05-2)	(0.70)	(1.5-2.5)	(150-1000)

*Converted to dry weight assuming 80% moisture. ( ) are wet weight levels.

Wet Paper

Figure 22.1 From Australian Fisheries March 1986 (Reproduced with permission)

Trace metal concentrations in marine organisms from Australian coastal areas subject to anthropogenic inputs

		mg/Kg (dry wt)				
Taxa	Location	Cadmium	Copper	Lead	Zinc	Ref.
Fish	Derwent Estuary Tasmania	Nd-.35	Nd-29	--	3-44	6
	Cockburn Sound(WA)	0.1-2.9	0.2-29	0.8-22.2	6-404	7
Molluscs	Tasmanian Waters	ND-99	105-620	--	2430-38,350	8
	Townsville (Qld)	0.38-3	5-13.6	ND-10	55.7-179.6	9
	Cockburn Sound(WA)	.5-43.5	3.5-200.5	3.5-24	85-5950	10
Crustaceans						
muscle	Cockburn Sound(WA)	0.5-7.5	6.5-50.5	1-15	43-161	10
Hepto-pancreas		13-341	20.5-567.5	1.5-50	110-1280	
Marine Plants	Cockburn Sound(WA)	0.2-1.6	0.6-9.3	0.2-1.7	24.7-169.4	10

ND - not detected

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Figure 22.2 Courtesy Australian Fisheries, reproduced with permission

Exercise 23 Practice Essay on Beach Erosion

Based on original exercise by Gwen Connolly.

Method

There is some concern about the stability of some of our beaches. Some have erosion problems while others seem to be relatively stable. Select one local beach and explain its present problems and how these problems are being overcome.

Then conclude your essay by recommending how protection of your beach can be achieved in the future.

1. Use the guide to construct a draft copy first, then write your final essay.
2. Both the draft copy and the final essay are to be submitted. (Show your teacher your draft copy before writing your final copy.)
3. Information for this exercise would come from:
   a. class work
   b. field trip to beaches
   c. Library information on your local beach

Guide for draft copy

Define the problem in general terms. What effects does it have on the natural environment? Describe the problem in the specific location that you have chosen.

What were the causes of the problem at this location?

Write a paragraph for each cause; tell of its effect on the environment (problem); describe the solutions which have been used to counteract this problem.

Put these causes-effect paragraphs with the attempted solutions in correct sequence.

Cause

Effect (problem)

Solution/s (preventative action)

Next effect (pattern)

Solution/s

Resulted in

Next effect

Solution

Describe the location at present:

Which solutions have been the most effective? Why?

Conclusion:

Recommend effective prevention for the future (from evidence given in your essay).

Wet Paper

Exercise 24
Methods used to combat oil pollution

Questions

Watch the video called *Planning for the inevitable* and read the brochure as shown in Figure 26.1 to answer the following questions on the national plan to combat pollution of the sea by oil.

1. In what year did the '*Braer*' run aground in the Shetland Islands?
2. How much oil was the '*Braer*' carrying?
3. Name the vessel that in 1992 broke up in *La Coruña*, Spain.
4. Predict which nation has the largest transport operation by shipping? Where does Australia stand in relation to this?
5. Name the tanker whose bow broke off in 1991 off the Western Australian Coast.
6. How many tonnes of oil did this vessel lose to the sea?
7. How many tankers per year travel inside the great barrier Reef?
8. What did the investigators believe caused the *M.V.Kirki's* bow section to break?
9. Who manages the 'National Plan to Combat Pollution of the Sea by Oil' and in what year was it introduced?
10. What is A.M.O.S.C. and what is its function?
11. If an oil spill occurred less than three miles off the coast and was likely to impact the shore, who would be the lead agency to deal with it?
12. Why is dispersant sprayed onto the oil?
13. State two key things that were learnt from the practice drill off Gladstone.
14. Recovery of the environment depends on what factors?
15. Who pays for the clean-up operations?
16. Do you believe that the National Plan will be able to combat a major oil spill if it occurred in your area?

Materials and equipment

Equipment required

- video player and monitor
- copy of the AMSA National Plan brochure
- copy of AMSA video —*Planning for the inevitable* available from:

  Marine Environment Protection Service
  AMSA
  PO Box 1108
  Belconnen ACT 2616
  Telephone: (06) 279 5935
  Facsimile: (06) 279 5076

AMSA
Australian Maritime Safety Authority

Exercise 25
Marine oil pollution

Questions

Obtain a copy of the brochure *Marine Oil Pollution — Its potential impact and control* and answer the following questions. The subheadings that follow refer to those in the brochure.

What is oil?

1. What is the difference between unrefined oil and refined oil. Name three types of refined oil.
2. What potential does each of the following have on pollution of the marine environment?
   a. crude oil
   b. light oil
   c. heavy oils

Oil pollution

1. What is the potential for oil pollution from each of the following situations.
   a. cooking bacon and eggs in the kitchen
   b. parking your car in the shopping centre
   c. marine sources spills
2. Plot a bar graph of the major inputs of petroleum to the marine environment.
3. What is the difference between chronic and acute oil pollution as outlined in the article?

The effects of an oil spill

1. The extent and type of damage oil can have on the marine environment depends on three main factors. What are they?
2. Lightest fractions of oil are soluble in sea water. How can these affect fish?
3. How can oil affect filter feeding animals such as mussels and oysters?
4. Sea birds experience major problems with an oil spill. Outline any two in the article.
5. What potential problems does oil have in the cleaning up of a sandy beach?
6. Draw a diagram to show the differences between these aspects of an oil spill:
   a. oxidation
   b. emulsification
   c. stranding
   d. evaporation
   e. spreading
   f. dispersion
   g. dissolution and biodegradation

Materials required

Copy of the brochure *Marine Oil Pollution*,

Available from:

The Training Officer
Marine Pollution
GPO Box 2595
Brisbane 4001

QUEENSLAND TRANSPORT

Exercise 26
Effect of oil on feathers

Based on an original idea by Erna Walraven with assistance from Derek Spielman.

Method

1. Fill a glass with clean water as shown in Figure 26.1.

   Dip a feather in and look into the glass. When you pull the feather out, it will be mostly dry. The trapped air layer makes the feather waterproof.

2. Make an oil spill by pouring some cooking oil onto the water surface. The floating oil may form a thin layer as it spreads out. This is what happens to oil when it is spilt in the sea if the weather isn't rough.

3. Push the feather into the water through the oil. How does the feather look now?

4. Pull the feather out of the glass. You'll find it's covered in cooking oil. The oil has stuck to the natural oils in the feather and clogged it. You will notice that the feather structure has been damaged.

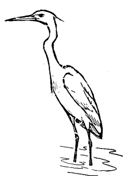
5. Get a clean glass and pour water into it. Add some detergent. Push a new feather into the detergent and water mixture.

6. Pull the feather out. Notice that it is completely soaked in water. The detergent removed the natural oils from the feather so that it is no longer waterproof and does not maintain its fine structure.

7. Read the information in Figure 26.2 and answer the questions in your note pad.

Materials and equipment (per group)

- feathers
- a glass
- water
- cooking oil
- detergent



Note: Use feathers that have been recently discarded, are clean, but not fluffy. Waterbird feathers work best if you can find them.

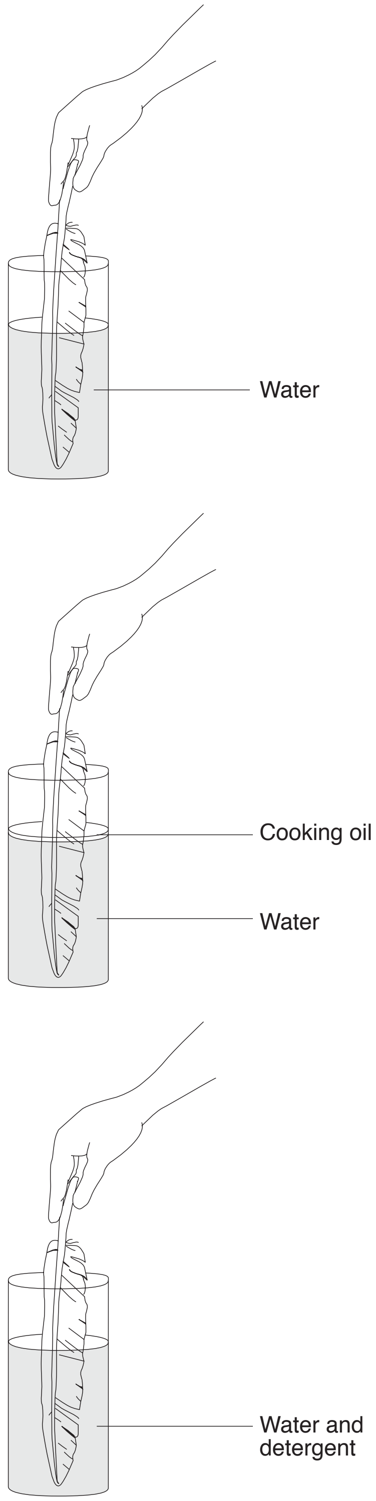
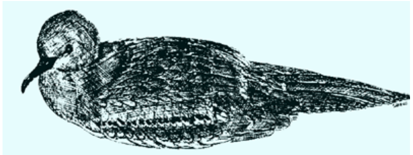


Figure 26.1 Experimental procedure
Wet Paper

Have you ever seen a bird preening its feathers?



The bird picks up on its beak some of its own natural preening oil. This is produced in a gland near its tail. Then the bird pulls its feathers through its beak, coating the feathers with oil, "zipping" up the barbules to make them waterproof. This makes the feathers strong enough for flight.

Birds' feathers are waterproof partly because of their structure and partly because birds preen their feathers with oils. Waterproof feathers insulate the bird - they protect the bird from cold and keep it dry and warm.

Unnatural oil destroys the insulating properties of feathers. If the feathers of a bird get clogged with oil from a spill, the bird can't fly, float or keep warm. The body temperature drops (hypothermia) which may kill it.

Rescuers wash the oil off the feathers with detergents. But detergents also wash off the bird's preening oils. A bird treated with detergents needs to be rinsed with water and looked after until its feathers are coated with preening oil again (about 2-4 weeks). If the bird is released before this, its feathers would become waterlogged and the bird would not be able to fly or feed or to keep warm.

When a bird is washed too roughly, its feathers can be damaged so that they cannot trap an insulating layer of air. Then the bird must be kept until the damaged feathers are replaced by new ones. This can take up to a year.

Birds are only one of many kinds of animals that can be affected by an oil spill.

This exercise demonstrates how feathers are naturally waterproof and the effects of oil and detergents on feathers. Detergents are used to remove oil from birds affected by a spill.

Questions

1. What is the effect of oil on feathers?
2. Make a drawing of the parts of a feather.
3. How does hypothermia effect birds?
4. Why are trained people required to wash birds after an oil spill?
5. Are birds warm blooded?
6. Who pays for washing oil-coated birds in your state?
7. What is the national plan in place to prevent oil spills?

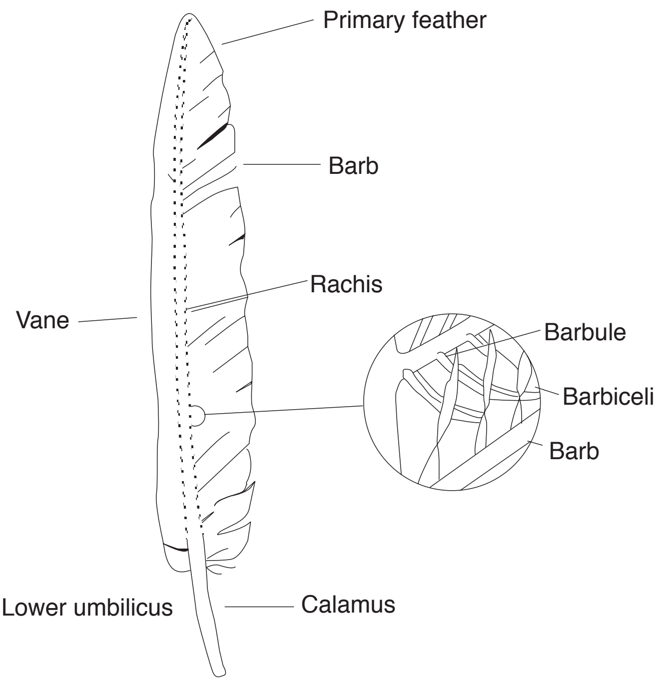


Figure 26.2 Article to read and questions to answer

Exercise 27 Oil spill in Hypothetical Bay

Questions

Read the newspaper article in Figure 27.1, study the chart in Figure 27.2 and answer the questions below.

1. A tonne of oil will take about 10 minutes to form a slick of about 0.5 mm thick and 500 metres in diameter. If the *M.V. Collintina* has been losing oil for 10 hours, calculate the size of the oil slick it will have produced.
2. Light oils such as petrol and diesel will evaporate almost completely in 4 hours. This crude oil from *M.V. Collintina* had some evaporation and samples suggest it will have lost 40% of its volume in 10 hours. Calculate the size of the slick.
3. Do you think that the slick will completely evaporate.
4. The danger of fire is greatest with lighter oils. Explain this statement.
5. Burning the oil is likely to be ineffective. Suggest why.
6. List three methods that could be used to stop an ecological disaster.
7. Response authorities have only four 1 km booms to protect areas of the coast. Suggest areas where these should be deployed so that the least ecological damage occurs. Explain why you have positioned the booms in these locations. Draw them onto the chart of Hypothetical Bay.

   Conditions on day of disaster:

Winds:	20 knot easterly	
Seas:	1.5 - 2 metres	
Tides:	2.4 m High	0600 Time
	0.2 m Low	1154 Time
	2.6 m High	1800 Time

   a. Predict the movement of the slick. Explain your answer.

   b. What areas of the tidal coastline will be affected and when will this happen. N.B. Oil slick moves at about 10% of the wind speed.
8. If the oil can be dispersed by aerial spraying, of dispersants how will this help solve the problem. Do you believe these sprays should be used and what is the justification for using dispersants?
9. Some of the oil (particularly the lighter elements) can dissolve in water forming toxic compounds. Which type of marine life will be in most danger?
10. The extent and amount of pollution damage may depend on the season. Suggest an explanation of this fact.
11. How will sea conditions affect the clean up operations.
12. Explain how the type of oil will affect the movement of the spill.
13. The On Scene Spill Model (OSSM) is a computer model that can be used to predict the movement of the oil spill. Suggest some local information that needs to be known to run the program.
14. Sea birds have a major problem if they become coated with oil.

    a. How does the oil affect them?

    b. Will it affect their young?
15. Mechanical removal is the best method of removing the oil from the shore. The removal is affected by the type of beach e.g. sand, pebble, rock and mud. Suggest some special problems each beach may present.
16. Suggest other problems that may be encountered in beach or shore clean ups.
17. Could mangrove areas be cleaned mechanically? What will be the effect of the oil on the mangroves? Should dispersant sprays be used to clean the area?
18. How does nature take care of oil pollution?
19. Who should pay for the oil clean up operation? Should the company owning the *M.V. Collintina* pay compensation for destruction of the environment?

OIL TANKER STRIKES REEF

At 11pm last night the Oil Tanker *M.V.Collintina* and the trawler Bernadette collided almost 6 miles east of the mouth of the Jensen River.

The Trawler Bernadette sank after the collision but the crew were rescued by a nearby trawler. The crew of the *M.V.Collintina* abandoned ship. No serious injuries were reported.

The oil tanker was carrying 20,000 tonnes of crude oil and was left with a gaping hole on the port side of the ship. The ship was losing oil at a rate of 1 tonne/minute. Luckily no fires or explosions have occurred.

A representative from the Australian Maritime Safety Authority has been sent to the area to take control of the situation. The Federal authorities have set into action the national plan to combat the pollution of the sea by oil.

Equipment from all over Australia has been sent to the area to control the spill. This includes helicopter borne aerial spray units, booms and self propelled oil recovery vessels.

Figure 27.1 Newspaper article

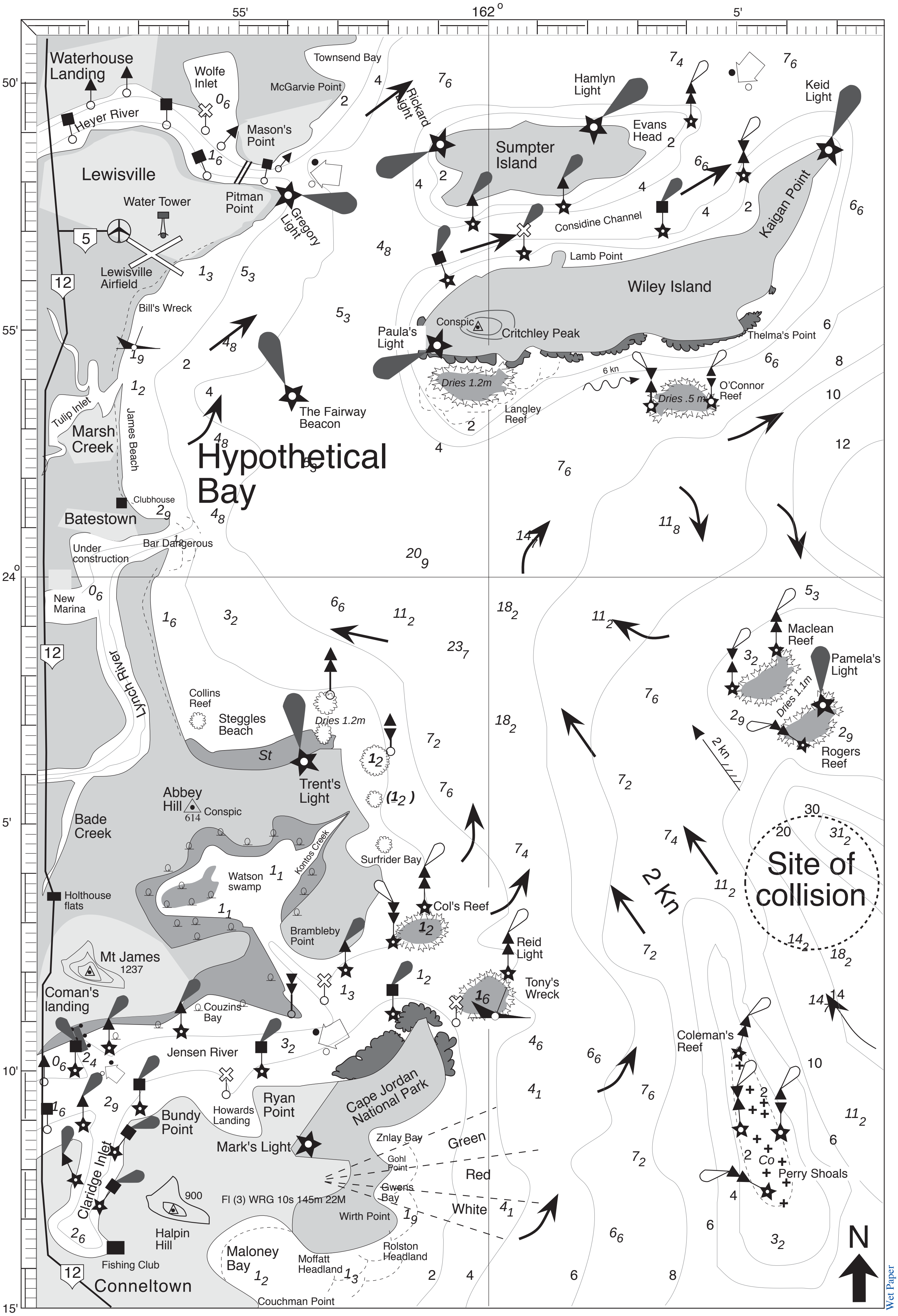


Figure 27.2 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 28
Point break

Method

1. Arrange an excursion to your local beach and find a cliff, headland or raised dune area like the one shown in Figure 28.2, so that you can overlook the waves as they travel towards the beach.
2. Complete the worksheet in Figure 28.1
3. Make a sketch of the headland system as if you were looking down from an aeroplane.

   Now mark the direction in which the waves are travelling. Add the position of the rocks and where the sand begins.

   Note also the areas where waves break and where sand accumulates.
4. Find out and record the difference between wave refraction and wave diffraction?

Questions

To be completed while studying the waves.

1. Can you tell where the water is flowing the fastest? Mark this on your drawing. What evidence do you have for this? How do surfers get out to the break point? Is there any special pattern to their surfing?
2. Why do the waves slow down as they near the rocks?
3. Does the tide make any difference to the size and breaking pattern of the surf at the point?
4. Find a local lifeguard or surfer and ask them if the rip at the point is the greatest at full tide, half tide or low tide. Ask the local to give a reason for the answer?
5. Look carefully at the waves as they break. Make a note of where sandbanks are.
6. Make a list of the materials that make up the headland. Is there any evidence that the headland is eroding?
7. What is the time between waves? Now calculate the speed at which the waves are travelling and try to determine the distance between wave crests.
8. How many waves are passing a fixed point in 10 seconds?
9. Why do surfers avoid certain waves?
10. Is there any reflection of waves as they strike the headland or refraction as they pass the point? If so, where does this occur?
11. There are three main types of waves: spilling, plunging and surging. Observe all the waves that break on or around the headland and record which types occur where. Do the same on a beach.
12. Do all waves have the same colour? Record the colours you see and suggest reasons for the colour changes.

Materials required

- pencil and worksheet
- compass or local knowledge of wind directions
- a partner
- camera (optional)

Wave watchers worksheet - beach

Sample worksheet

Sea conditions:

Date:	Wind speed	Water clarity in surf zone	☐ ☐	murky clean
Time:	Water temperature	Tide (ebb or flood)		

Taste of surf ....

Smell of surf ....

Wave colour ....

Wave sound ....

Wave height (max over 5 mins)
- ☐ 0 - 0.5 m
- ☐ .5 - 1.0 m
- ☐ 1 - 1.5 m
- ☐ 1.5 - 2.0 m
- ☐ 2.0 - 2.5 m

Wave Shape
- ☐ smooth
- ☐ choppy
- ☐ broken white caps
- ☐ clean lines approaching the shore
- ☐ other ....

Wind direction
- ☐ on shore
- ☐ off shore
- ☐ nil

Figure 28.1 Sample worksheet

Wet Paper

Figure 28.2 Local headland

EXERCISE 29
MAKING A BEACH WALKWAY

The exercise focuses on beach management procedures.

METHOD

1. Find out who is responsible for local beach management in your area and obtain permission to build a walkway to your local beach.
2. Submit the plans similar to those opposite and obtain relevant approvals. Use the materials as outlined in Figure 29.1 as the basis for your fence.
3. Apply for a grant and gain community support for the project. It is hoped a coast care grant scheme may be available in the near future.
4. Prepare a statement of what you intend to do and do a letter box drop to local residents in the area.
5. Write a press release for local media and ring them up and ask for a journalist to help write an article.
6. Finally assemble the materials and construct your walkway.
7. Build a sign saying what the project is about and ask a local member of council to officially open the walkway.
8. Make a study of the effect of the walkway and how it fails or succeeds in conserving sensitive dune areas.

MATERIALS AND EQUIPMENT (PER GROUP)

Equipment required

- fence posts as detailed
- plastic coated fence wire
- wire twitchers
- shovels
- large hammer
- camera
- sign - find a friendly signwriter

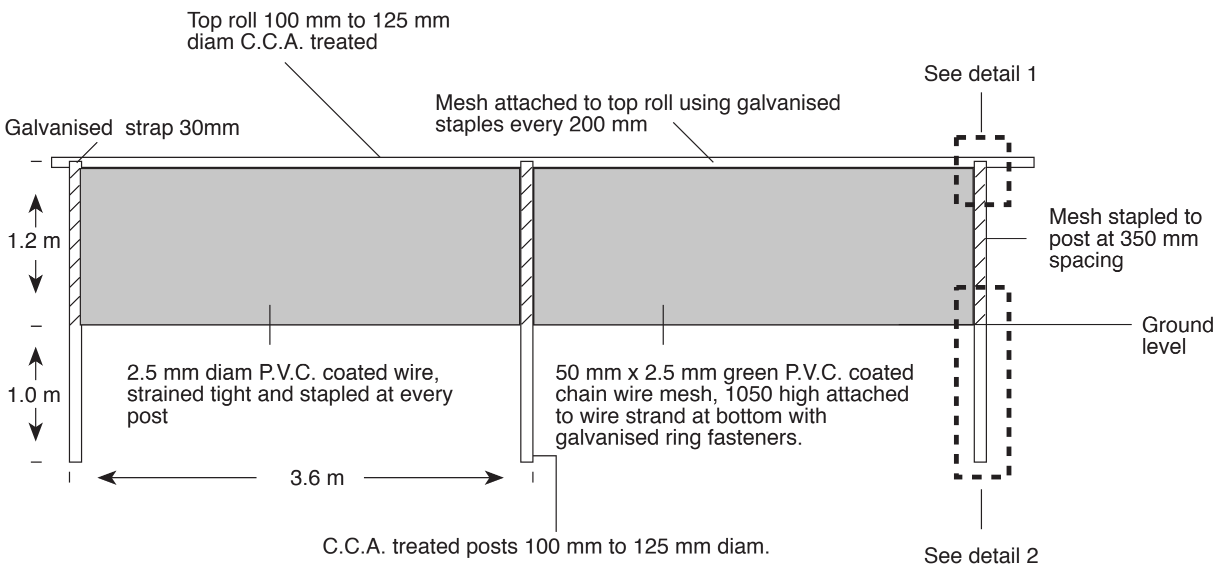


Figure 29.1 Construction details (GCCC - Special Projects)
Wet Paper

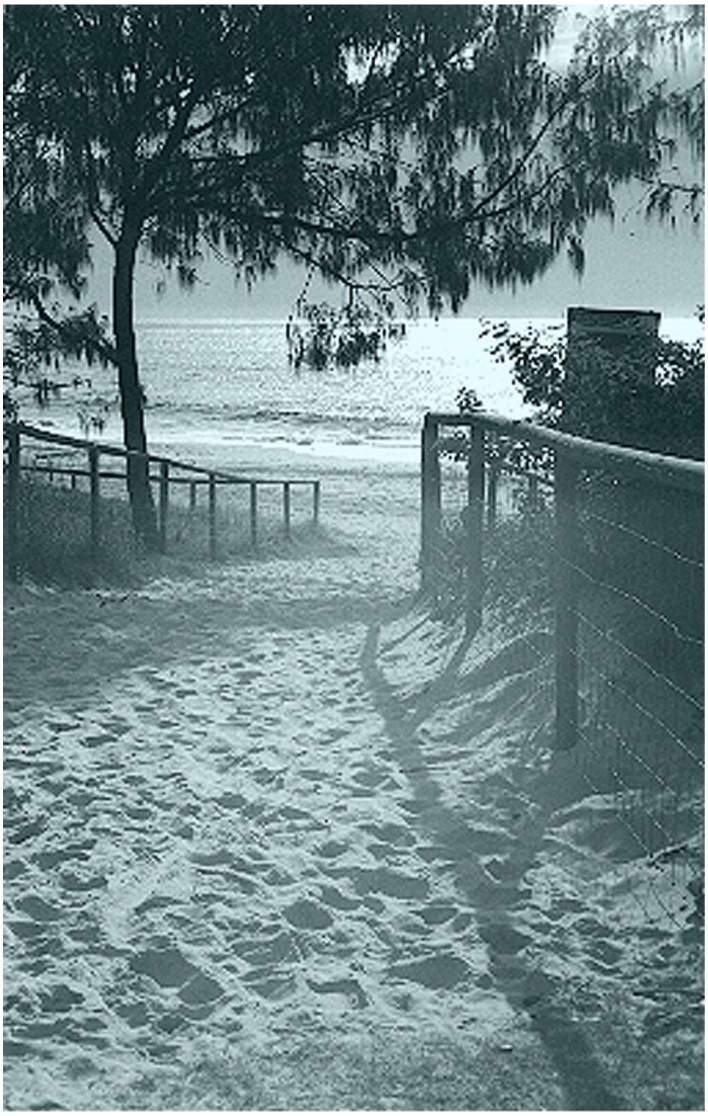


Figure 29.2 Completed fence

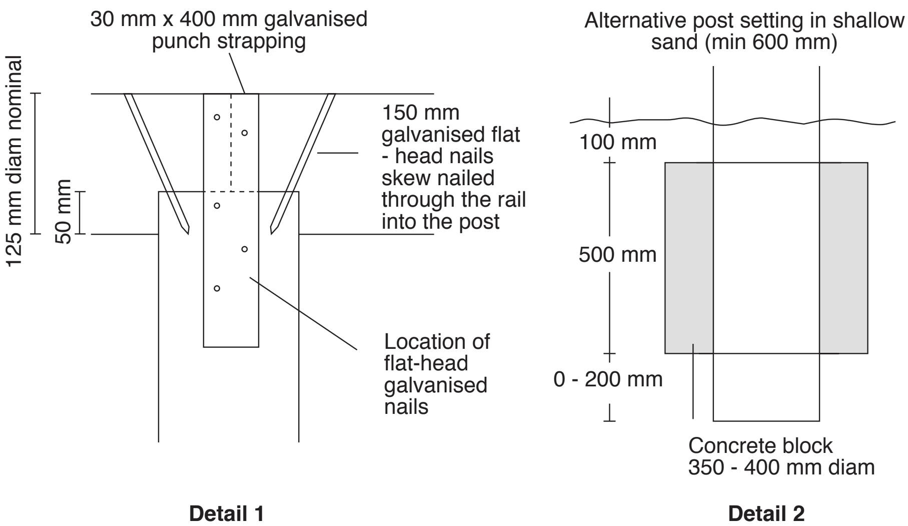


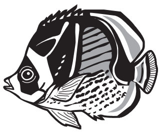
Figure 29.3 Details 1 and 2 from Figure 29.1 (GCCC - Special Projects)
Wet Paper

Exercise 30

Seawater test

Time 30 minutes

Use your textbook to answer the following questions:



Knowledge and understanding

1. Which of the following statements about salt are FALSE:
   a. Salt contains the elements of sodium and chlorine.
   b. Salt is an inorganic material.
   c. Salt crystals are a combination of salt molecules held by ionic bonds.
   d. The salt in sea water is made up of only sodium and chloride elements.
2. Which of the following statements are TRUE:
   a. Organic matter is more likely to dissolve in water than inorganic material.
   b. Environments with high levels of dissolved oxygen are usually able to sustain a low species diversity.
   c. Water becomes more acidic as the pH increases.
   d. The amount of phosphorus in water can be reduced by reducing the amount of fertilizer.
3. If a salt solution being made up in class had 5 grams of salt added to 200 millilitres of water, then the concentration of the solution produced in ppm would be:
   a. 5000 ppm.
   b. 40 ppm.
   c. 50000 ppm.
   d. 25000 ppm.
4. If a group of students is required to make up 200 millilitres of a 35g/L salt solution (35000 ppm), how much salt would need to be added to the 200 millilitres of water?
   a. 70 grams.
   b. 7 grams.
   c. 3.5 grams.
   d. 1000 ppm.
5. Using the calibration graph shown in Figure 30.1, how many drops of silver nitrate would indicate a salinity of 25 g/litre:
   a. 15 drops.
   b. 20 drops.
   c. 25 drops.
   d. 30 drops.

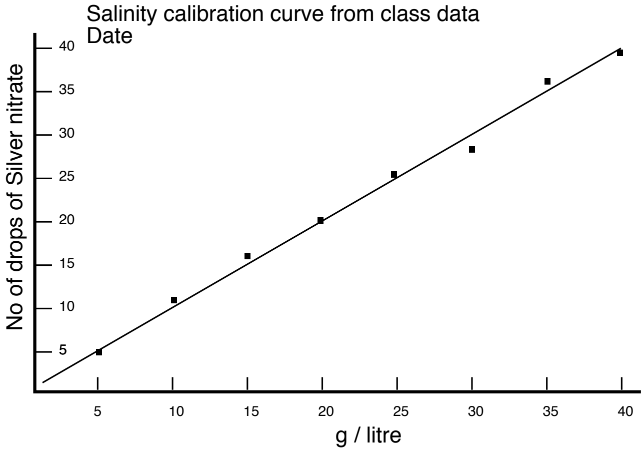


Figure 30.1

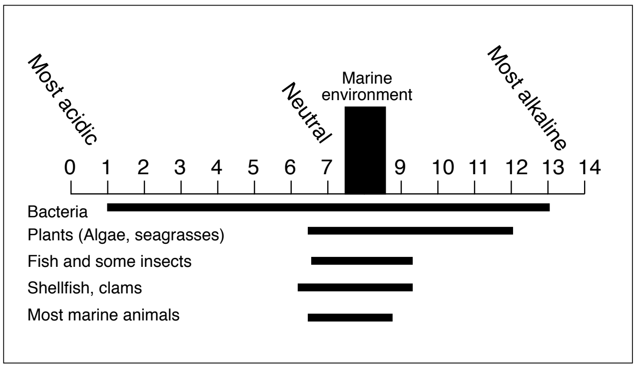


Figure 30.2

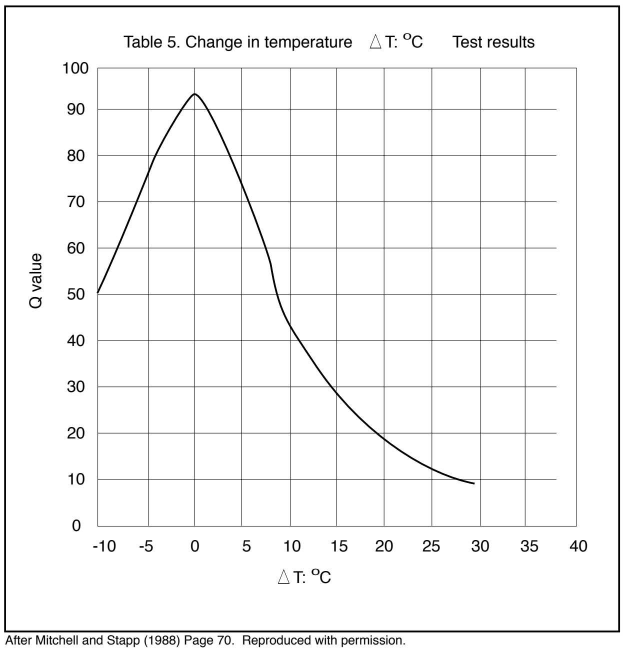


Figure 30.3

6. The major gases that dissolve in sea water are nitrogen, oxygen and carbon dioxide. The amount of gases that dissolve depend on three factors. Which of the following is NOT one of those factors:

   a. the temperature of the sea water.

   b. the depth of the water.

   c. the salinity of the water.

   d. the BOD of the water.

7. Faecal coliforms are:

   a. bacteria derived from faeces of animals.

   b. a type of test for water pollution.

   c. a macroscopic animal which breaks down faeces.

   d. harmful bacteria found in animal faeces.

8. Which of the following organisms had the greatest tolerance to pH in Figure 30.2?

   a. shellfish and clams.

   b. bacteria.

   c. algae.

   d. fish.

9. Which of the following organisms would most likely survive in alkaline waters in Figure 30.2?

   a. sea grasses.

   b. fish.

   c. clams.

   d. most marine animals.

10. The BOD test:

    a. measures the amount of organic material in water.

    b. measures the amount of oxygen dissolved in the water.

    c. measures the amount of phosphates in the water.

    d. measures the Q factor of the water.

11. The measurement of temperature is the difference from one point to another so you have to select two regions of the river or estuary. The thermometer is lowered to a depth of 200 mm and the temperature is recorded. Another reading is taken one kilometre upstream using the same method and the same thermometer.

    If the temperature at point A is 16 degrees centigrade and 1 kilometre upstream the temperature is 21 degrees centigrade. Use the table in Figure 30.3 to calculate the Q value.

    The Q value would be:

    a. 50.

    b. 65.

    c. 75.

    d. 85.

12. Cultural eutrophication is:

    a. an enrichment of the water, usually by phosphorus and human pollution.

    b. an enrichment of the water by natural means causing plant blooms.

    c. a build up of organic matter in water causing acrobic conditions.

    d. a build up of phosphates in the coastal sand dunes.

13. Denitrifying bacteria:

    a. are bacteria which convert the atmospheric nitrogen into nitrates.

    b. are bacteria which convert nitrates into nitrogen which releases back into the atmosphere.

    c. convert plant material into nitrates which are released into the water.

    d. are found in the root nodules of She-Oaks.

14. The turbidity of the water is measured by:

    a. using a pH meter.

    b. using a secchi disc.

    c. collecting a sample of water and boiling off all the water and weighing the residue.

    d. using a solution of silver nitrate.

15. High levels of turbidity cause all but one of the following consequences:

    a. a less diversity of Aquatic organisms.

    b. water becomes warmer as suspended particles absorb heat from the sun.

    c. water becomes oxygen enriched.

    d. reduction of photosynthesis.

16. High concentrations of total solid leads to all but one of the following:

    a. reduction in nitrate and phosphate levels.

    b. a decrease in water clarity.

    c. a decrease in the number of filter feeder living on the sea floor.

    d. an increase in the amount of phytoplankton activity.

17. Why is the determination of current speed and direction important when we are considering pollution? What instruments can be used to measure current?

18. How is water pollution measured?

Estuary Description	Name of Estuary	Lower Estuary			Middle Estuary			Upper Estuary			
Unpolluted estuaries	Mooloolah	0.414	-	-	0.440	0.574	-	0.719	0.646	-	-
	Burrum	0.567	-	-	0.546	0.645	-	0.756	0.763	0.770	-
Nutrient enriched estuaries	Burnett	0.549	-	-	0.684	0.888	-	1.178	1.118	1.051	-
	Hays Inlet	0.848	0.864	-	1.136	-	-	1.270	-	-	-
	North Pine	0.568	-	-	0.972	1.630	-	1.445	-	-	-
	Caboolture	-	-	-	0.766	0.882	1.154	1.344	1.745	2.347	1.840
Nutrient enriched estuaries with significantly light limited reaches	Logan 80/81	0.590	0.935	-	1.073	1.443	1.884	2.110	1.986	-	-
	Logan 83/84	0.590	0.985	-	1.280	1.714	1.796	1.600	-	0.800	-
	Albert	1.141	1.237	-	1.212	1.093	-	0.836	0.577	-	-
	Mary	0.408	0.567	-	0.998	1.197	1.132	0.907	0.698	0.684	-
	Brisbane	0.833	0.932	1.4.08	1.771	2.177	1.944	1.793	1.546	0.726	-
	Fitzroy	-	-	-	0.978	1.179	-	1.457	1.695	1.383	-
Small creek	Petrie Creek	0.805	-	-	1.903	-	-	3.295	5.418	6.920	-

Figure 30.3 Mean total nitrogen levels (mg/l N) in some Queensland Estuaries (data supplied courtesy Dept. of Primary Industries)

19. From the table of data in Figure 30.3, answer the following questions:

    a. Which estuaries are regarded as unpolluted and which are nitrogen enriched?

    b. Which river had the highest level of nitrogen (mg/l) and what was this value?

    c. Graph the value for the Logan River for the period of 1980/81 and 1983/4. How have the values changed? Propose a suggestion to explain these values.

    d. Attempt to explain the reason why the nitrogen levels are generally higher in the upper estuaries than the lower estuaries.

    e. Where may the sewage be entering Petrie Creek? Explain.

    f. Suggest other nutrients which may have shown similar trends to the nitrogen in the table above.

    6 marks

20. Muswellbrook, Singleton, Maitland and Newcastle are towns situated on the Hunter River system of NSW. Each town is approximately 50 kilometres apart on the Hunter River and use the water for domestic, agricultural and industrial purposes.

    What problems may be caused by having all four towns on the same river? Will it make the detection of the source of pollutants harder to track down?

21. Refers to Figure 30.4.

    a. Organisms which can only live in special environmental conditions are said to be indicator species. These organisms have a low tolerance range. Which of these species is an *indicator species*?

        a. catfish

        b. mullet

        c. yellow belly

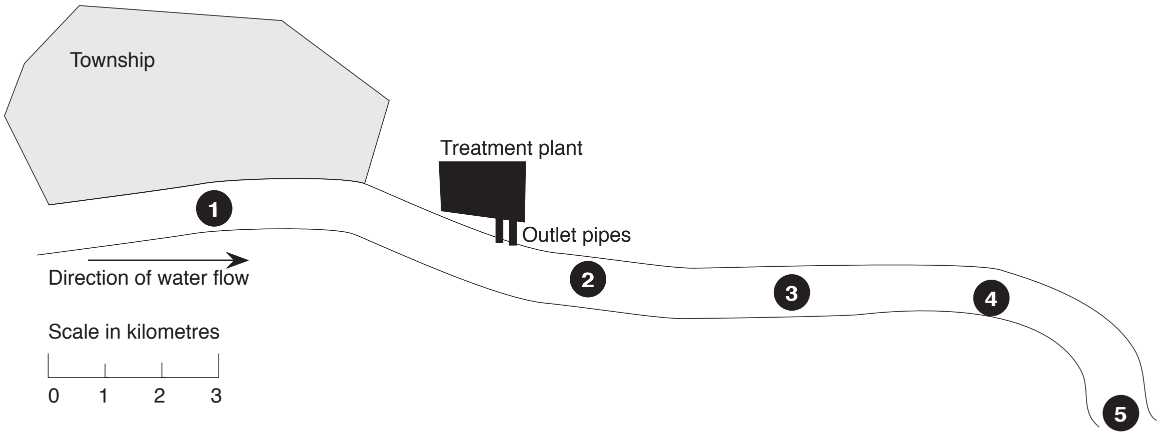
    b. Why will the oxygen concentration decrease as you progress from position 1 to position 5?

    c. Discuss the water clarity, based on secchi disc readings, from position 1 to 5. What may have happened between position 1 and 2?

    d. What effect might the increase in mineral ion concentration have on the aquatic life from positions 3 to 5?

Exercise 30 Answers

1. d
2. d
3. d
4. b
5. c
6. d
7. a
8. b
9. a
10. a
11. c
12. a
13. b
14. b
15. c
16. d

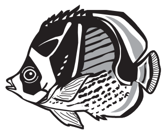


Variable	Position 1	Position 2	Position 3	Position 4	Position 5
Water quality by Secchi disc (cm)	200cm	10cm	12cm	60cm	150cm
Temperature	22.3^{0}C	26.2^{0}C	25.1^{0}C	25.0^{0}C	24.2^{0}C
Oxygen content	8.5 ml/l	1.0 ml/l	0.5 ml/l	3 ml/l	4 ml/l
Fish	Yellow Belly Catfish Mullet	Mullet	Nil	Catfish Mullet	Catfish Mullet
Mineral ions concentration	Low	High	High	High	High.

Figure 30.4 Information for Question 21

Exercise 31
Beaches Test

Time 30 minutes



Use your textbook to answer
the following questions:

Knowledge and understanding

1. A low lying ridge of sand or pebbles joined to the land at one end and terminating at the other in deeper waters is called a:

   a. bar

   b. spit

   c. tombolo

   d. coorong

2. The solid mounds found in Shark Bay ,Western Australia which are formed by the microbial action of cyano-bacteria trapping sediments are called;

   a. tombolos

   b. stromatolites

   c. rock corals

   d. sea stacks

The next question refers to the information in the table below

Class	Subclass	Equiv. Diameter	Average slope of beach in degrees
Boulder		256 cm or more	>25 degrees
Gravel	Cobble Pebble Granule	65-256 mm 4 - 64 mm 2 - 4 mm	10 - 25 degrees
Sand	Very course Course Medium	1 - 2 mm .5 - 1 mm .25 - .5 mm	5 - 9 degrees
Mud	Fine sand Silt Clay	.07-.25 mm .003-.07mm .003 or less	< 5 degrees

Wet Paper

3. Which of the following statements are true:

   a. beach slope increases where wave action increases

   b. beaches which have high energy waves will have fine sand and a slope of < 5 degrees

   c. muddy beaches will have a steep slope

   d. muddy beaches will have sand grains of 1 - 0.5mm

4. The distance over which the wind can actually manufacture waves is called:

   a. orbit fields

   b. the fetch

   c. shoaling

   d. reflection

5. The speed of a wave in a certain direction that can be expressed in metres per second is:

   a. celerity

   b. wave frequency

   c. orbit fields

   d. airy waves

6. A wave approaching the South East coast of Australia has a length of 25 metres and a height of 2 metres over a period of four seconds. The celerity of the wave will be:

   a. 100 metres/second

   b. 0.5 metres/second

   c. 6.25 metres/second

   d. 8 metres/second

7. When a wave bends as a result of shallow waters around a point, refraction is said to occur. A right angle drawn to the crest is called an:

   a. orthagonal

   b. reflected wave

   c. adjacent

   d. ryanogon

8. The ASLA has identified four types of rips. A rip that occurs where a depression suddenly occurs in a beach profile is termed:

   a. a travelling rip

   b. a fixed rip

   c. a flash rip

   d. a permanent rip

9. Which of the following statements about microridges is FALSE:

   a. microridges mostly contain a variety of sand grain sizes

   b. the size of the microridge is dependant on the energy of the wave bore

   c. microridges are minute ridges on a beach containing sand dropped when the wave bore stalls

   d. microridges are minute ridges of sand framed on a beach that can be studied microscopically to show lateral sand movement

10. The maximum distance the wave bore travels up the beach is called the _______________. The wave bore is the broken part of the original wave as it runs up the beach. The missing word is:

    a. beach berm

    b. swash zone

    c. accreting zone

    d. shoaling zone

11. Which of the following is NOT a sign of erosion:

    a. no microridges visible

    b. sand is hard in the swash zone

    c. black heavy minerals washed to the head of the beach

    d. distance between wave bore decreasing

12. Dune vegetation plays an important role in the formation and stabilization of coastal sand dunes. Which of the following statements concerning dune vegetation is FALSE:

    a. prevents wind erosion by decreasing wind speed at ground level

    b. prevents direct wave erosion by strongly binding the sand with roots

    c. dune vegetation can tolerate a hostile environment — high winds, salt spray, little water

    d. the sand provides a stimulus for the plants to grow and the dune will increase in size

13. Fretting is:

    a. when the dunes are eroded, and the roots of the plants and shrubs are left dangling on the erosion scarp

    b. the formation of pioneer vegetation on the erosion scarp

    c. the washing sway of the primary dune in storm surges

    d. the formation of offshore beaches called storm bars

14. What is a sea stack and how is it different from a sea arch?

15. What are orbit fields and what do they contain?

16 Discuss how the large sand islands of Fraser and Moreton Island were formed.

Information processing and reasoning

Time 30 minutes

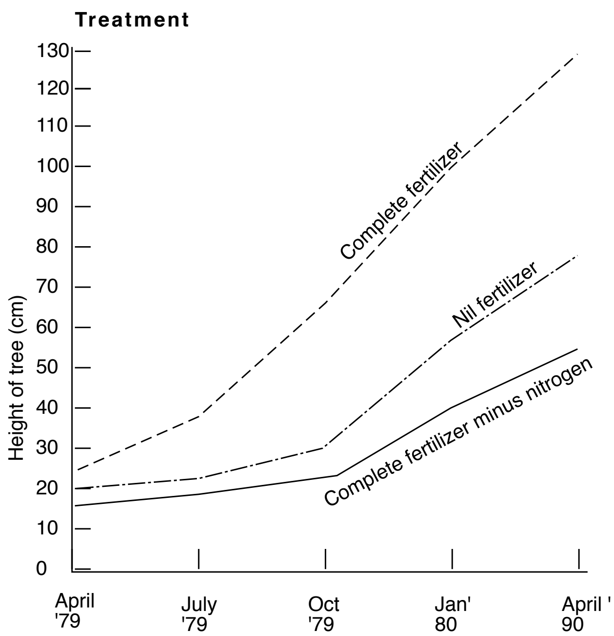
1. The Beach Protection Authority believes "The control of windblown sand and retention of vegetated and naturally stable coastal sand dunes are a valuable means of decreasing coastal erosion and because of this the Authority implements a broad research program into the management of coastal sand dunes in QLD".

   The graphs in Figure 31.1 show the effect of fertilizers especially nitrogen, in the growth of horsetail she-oak trees.

   a. What was the average height of trees after 12 months of growth with no fertiliser?

   b. What was the growth rate of the she-oaks in the first 12 months after the addition of complete fertiliser?

   c. How would you explain the fact that fertiliser minus nitrogen had a negative effect on growth rate?



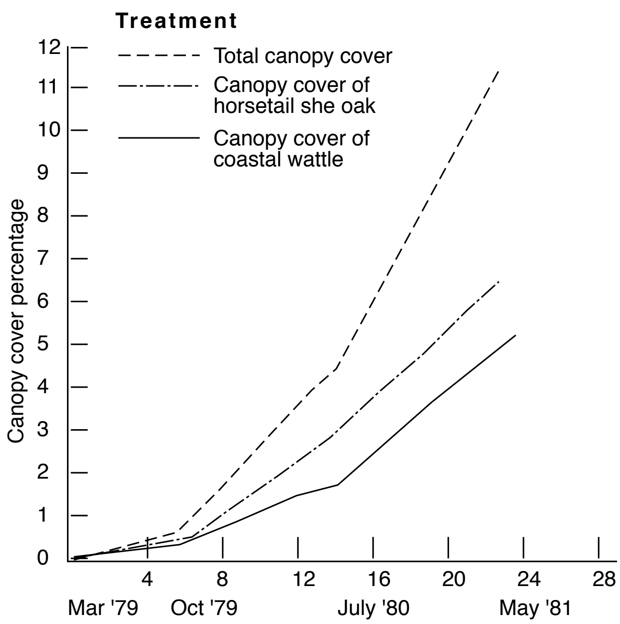


Figure 31.1 Data from Beach Protection Authority
Wet Paper

2. The tree and shrub planting program on the Noosa spit involved about 22,400 seedlings. The growth rate and survival of these seedlings were monitored and a steady improvement in the total cover provided by the tree and shrub species was recorded and is shown below.

   a. What would the average canopy coverage of she-oaks *Casuarina equisetifolia var incana* be after 20 months?

   b. Which species proved to have the most canopy coverage?

   c. Explain how the soil conditions and ground flora and fauna may have changed over the two years .

3. Vegetation transects recorded at Clifton Beach and Half Moon Bay are shown in Figure 31.2.

   a. What would the appearance of mangroves 60 metres from Half Moon Bay indicate?

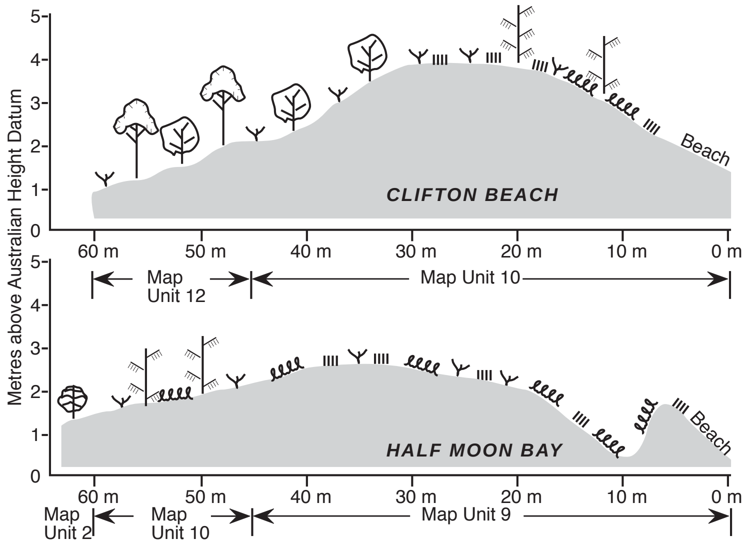
   b. What vegetation would be considered to be climax vegetation? Explain why.

   c. Which beach is more likely to have some protection from the sea? Explain your answer.

   d. Which beach is more likely to have coarse sand? Explain your answer.

   e. Describe each of the transects. Discuss the size of herbland zone, size of coastal she-oak (*Casuarina equisetifolia var incana*) on the beach ridge.

   f. Which beach would more likely represent an area which has had recent and rapid sand accretion? Explain why.



LEGEND

SYMBOL	PLANT	MAP UNIT	COMMUNITY DESCRIPTION	SYMBOL
	Mangrove	2	Mangroves	Littoral
	Ipomoea Cyperus Grasses	9	Herbland	
	Casuarina	10	*Casuarina equisetifolla* var. *incana* low open-forest to low woodland	Beach ridge
	Scrub Forest	12	Low closed-forest to open scrub	

FROM BEACH PROTECTION AUTHORITY (Undated graph)

Figure 31.2 Dune profile data

Exercise 31 Answers

1. b
2. b
3. a
4. b
5. a
6. c
7. a
8. c
9. d
10. b
11. d
12. b
13. a

MARINE BIOLOGY

EXERCISE 32
KEY TERMS

QUESTIONS

1. Read the information box in Figure 31.1. Now use your textbook to locate the chapters that discuss plankton nekton and benthos to write definitions of the following key terms:
   - nekton
   - benthos
   - pelagic
   - food chain
   - feed web
   - photic zone
   - bioaccumulation
   - producer
   - consumer
   - decomposer
2. What is a plankton net and how is it used?
3. Use your textbook to construct a table to distinguish between the following terms:
   - megaplankton
   - ultraplankton
   - microplankton
   - mesoplankton
   - nannoplankton
   - macroplankton
4. How many μ are in each of the following metres?

   a. 0.5 m

   b. 0.005 m

   c. 1.0 m

   d. 0.0002 m

   e. 10.0 m

Writing definitions

In writing definitions, the following format could be used.

Item … class … distinguishing feature … example.

Example

1. The definition of the word ‘Plankton’ could be written as follows:

   Plankton are very small organisms that drift in the sea, most of which have to be seen with a microscope

   Item … Plankton

   Class … very small organisms

   Distinguishing feature … that drift in the sea

   Example ... most of which have to be seen with a microscope
2. Note that not all definitions require an example.

Task

Identify the parts of the following definition:

Phytoplankton are plant plankton that contain chloroplasts such as green algae.

Item:

Class:

Distinguishing feature:

Example

Figure 32.1 How to write definitions (based on an original activity by Gwen Connolly, St. Augustine's College, Cairns)

Exercise 33 Plankton of your local area

Based on an original activities by Tim Ryan, Jack Marsh, Bob Moffatt and Geoff Jensen.

Method

Part A

1. Obtain the piece of plankton net offcut or graph paper and focus it under low power of the monocular microscope and determine the magnification.
2. This is calculated by multiplying the magnification marked on the ocular (eye piece) by the magnification marked on the objective lens (nose piece); e.g. ocular 5x and objective 5x = magnification of 25 times.
3. Determine the magnification for high power of the microscope.
4. Determine the diameter of the low power field of view by focusing on a piece of graph paper and counting the number of millimetres you can see.
5. Convert this measurement to micrometres.

   1mm = 1000 μm. (micrometres)

Materials and equipment (per group)

- fresh plankton sample
- a steromicroscope and monocular microscope
- plankton sample
- pasteur pipette
- petri dish and small piece of plankton offcut or graph paper
- concave glass slides
- glass cover slip
- iodine solution
- paper towelling
- Rose Bengal stain as described in Part E (page 74)

6. The field of view for the high power is calculated by first working out the increase in magnification from low to high power. Then dividing the field of view at low power by this value. For example:

   Step 1 Calculate the magnification increase.

   $$\frac{\text{Magnification H.P.}}{\text{Magnification L.P.}} = \frac{5 \times 40}{5 \times 5} = \frac{200}{25} = 8 \text{ times}$$

   Step 2 Divide the field of view for low power by this increase in magnification.

   Field of view at low power = 4500 μ m

   So field of view at high power

   = 4500 μ m ÷ 8

   = 560 μ m

   We can now measure how big plankters are at high power.

7. Place 1 mL or 20 drops of plankton sample into a petri dish and draw as many different types as possible. Use the lowest possible light intensity.
8. Use a fine paint brush to transfer interesting specimens to a concave glass slide and add two drops of water from the original sample.
9. Focus under high power and again draw the organism. Estimate the size of the organism.

   Note that you can measure size directly if you have built a plankton net slide as described in Activity 77 on page 171 and you know the mesh size of the plankton net.

10. If you have a live sample, place it in a plankton viewer as shown in Figure 33.1.

    If the organism is moving, calculate the speed it is movement

    Speed = Distance ÷ Time

11. Use the identification keys on Pages 76 and 77 to attempt to identify the organism.
12. Use high power to draw and identify (if possible) some forms of phytoplankton.
13. Answer the following questions
    a. What is the magnification of low power and high power of your microscope?
    b. What is the field of view of the microscope under low and high power?
    c. Describe the motion of the plankton as it moves. What causes this movement?
    d. Estimate the size and speed of 3 types of plankton. Calculate the speed in micrometres per second and km/h.
    e. How many different forms of plankton did you observe?

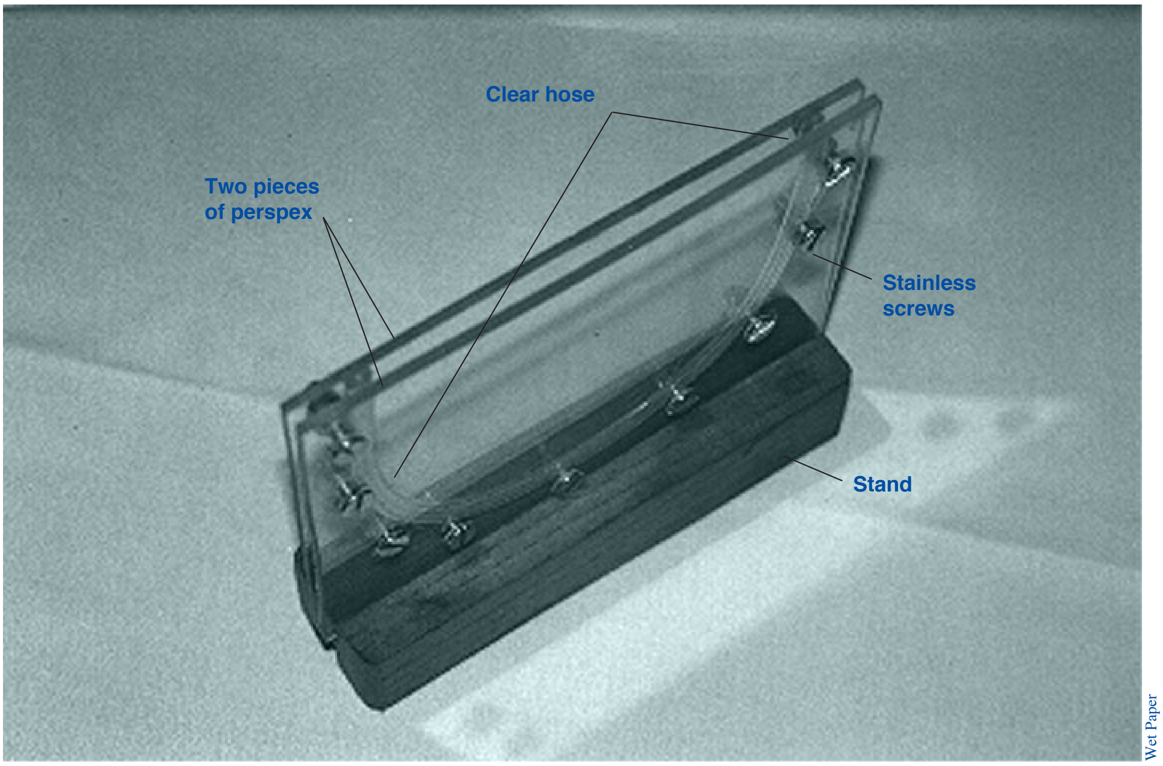


Figure 33.1 An easy way to view live plankton (Construction by Geoff Jensen, Innisfail State High School)

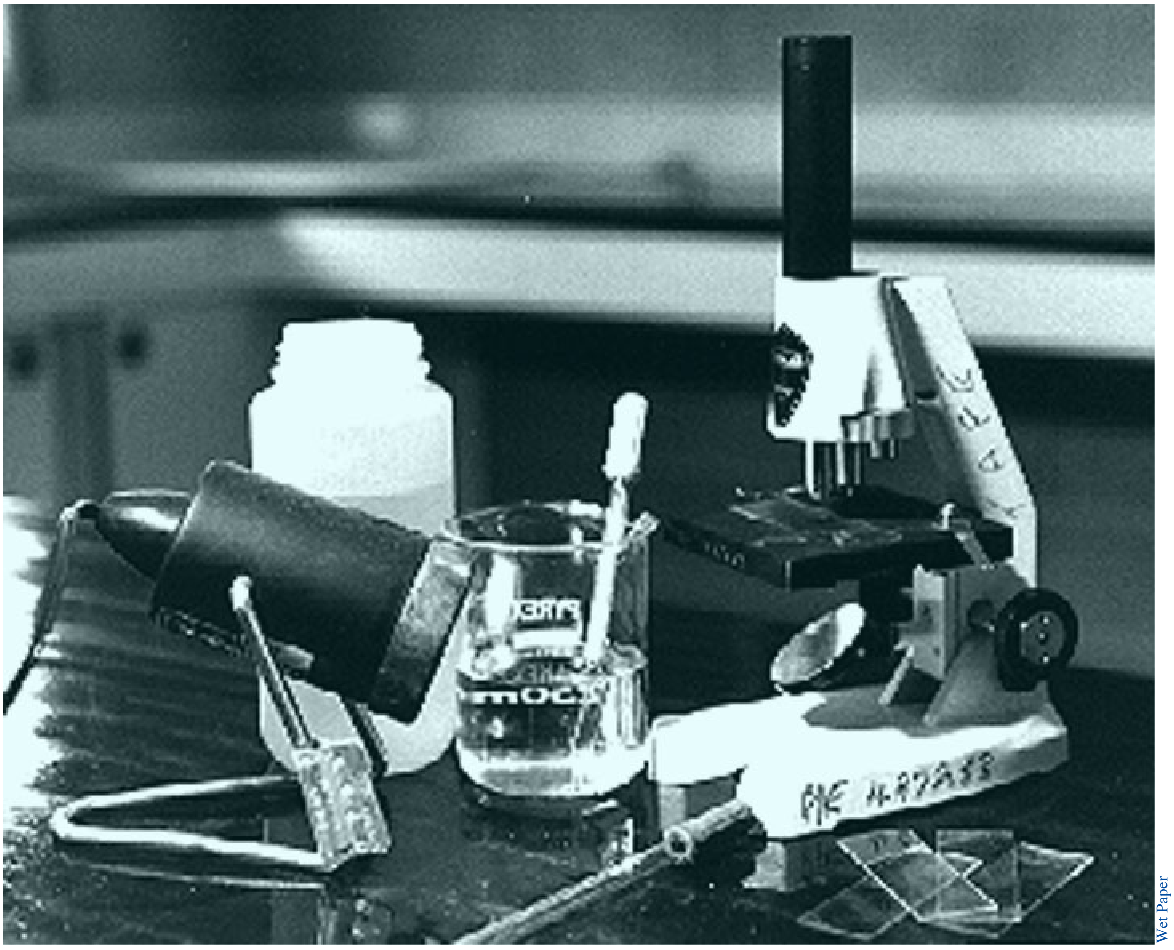


Figure 33.2 Microscope used for calculating plankton size

Part B Response to stimuli

In this part you are going to investigate the activities of plankton and how they respond to certain stimuli.

1. Place 2 drops of the plankton sample onto a piece of lens tissue on a concave slide.
2. Carefully place a glass cover slip over the samples.
3. Observe the planktonic organisms trapped in the fibres of the lens tissue. Use as little light as possible.
4. Irrigate the slide with iodine solution. Observe the effect of different concentrations of iodine on the organisms.
5. In a new sample (repeat steps 1, 2 and 3) irrigate the slide with a salt solution. Observe the effects of different concentrations of salt.
6. On a new sample add some yeast and observe the behaviour of the plankton.
7. On a new sample increase light intensity and record the effect.

   Stains are dyes that produce an artificial colouration of the organism. These stains highlight transparent parts of the organism.

8 Answer the following questions:

   a. What is the purpose of placing the sample onto lens tissue on the slide?

   b. What is the effect of placing the iodine solution on the organisms? Draw the specimen after being stained.

   c. Describe the effect of increase salt concentration on the plankton.

   d. The yeast is food for some plankton. Describe how plankton feed.

   e. How is the activity of the plankton affected by heat?

   Tips: If the experiment is going to be completed over a couple of days aerate the sample overnight.

Part C The steromicroscope

1. The steromicroscope as shown in Figure 33.3 is different from a monocular microscope because it has two eyepieces, A and B.
2. Carefully remove the microscope from the case (not shown) and carry it with the stainless carry handle D to a place with light coming through a window. Place the base E, on a firm desk.
3. To focus the microscope, take some plankton (I) from your sample with an eye dropper (H) and place in a petri dish (F) that has been placed on a white stage fixed with a screw (G). Note, if you are using live plankton, you may get a better view by unscrewing G and using the black side of the stage disc.
4. Locate the fixed eye piece B and the adjustable eyepiece A. Move A_1 and B_1 apart or closer to fit your eyes.
5. Now close one eye, look through B and use the focus knob (C) to focus on your plankton. Now open your other eye and use eyepiece A to bring your plankton into perfect focus.
6. Use the identification illustrations in Figures 33.5 and 33.6 to identify the plankton in your sample.
7. Classify each into Phytoplankton and Zooplankton and make illustrations of each.

Part D Looking at live plankton

1. Collect a fresh sample of plankton using a net as shown in Figure 33.4.

   Drag the net for about ten minutes at a very slow speed. The best time to observe live plankton is at night, because during the day they tend to migrate downwards.

2. When you have trawled your net, haul it on board being careful not to spill any of the plankton.

   You can keep plankton alive for the next day by keeping them in the fridge or under ice.

3. So you can see plankton move freely, build a plankton viewer like the one shown in Figure 33.1. To do this, clamp two pieces of perspex on either side of a piece of clear aquarium hose by using stainless screws.
4. Pour the plankton into the viewer and observe plankton movements.

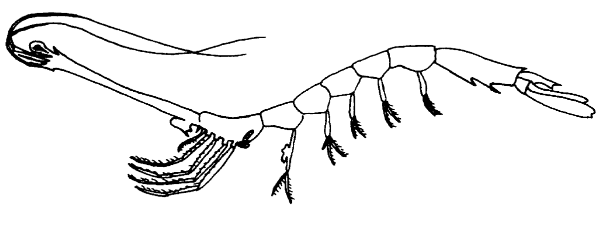
   Alternatively you can use a test tube and handlens.

Part E Stain your dead plankton

1. Look at Figure 33.3 and notice that the many parts of the plankton in the petri dish have dark outlined spots.
2. These darkened places have been caused by a stain that has been allowed to be absorbed by the animal into places where keratin is found.
3. The stain is called Phenolic Rose Bengal and is made from Rose Bengal 1.0g, $CaCl_2$. $2H_2O$ 0.01 g, Phenol 5% in 100 mLs of distilled water.

   The stain and microscope are available from:

   Selbys Scientific
   368 Ferntreegully Rd
   Nottinghill, Vic, 3168.
   Telephone 13 2990



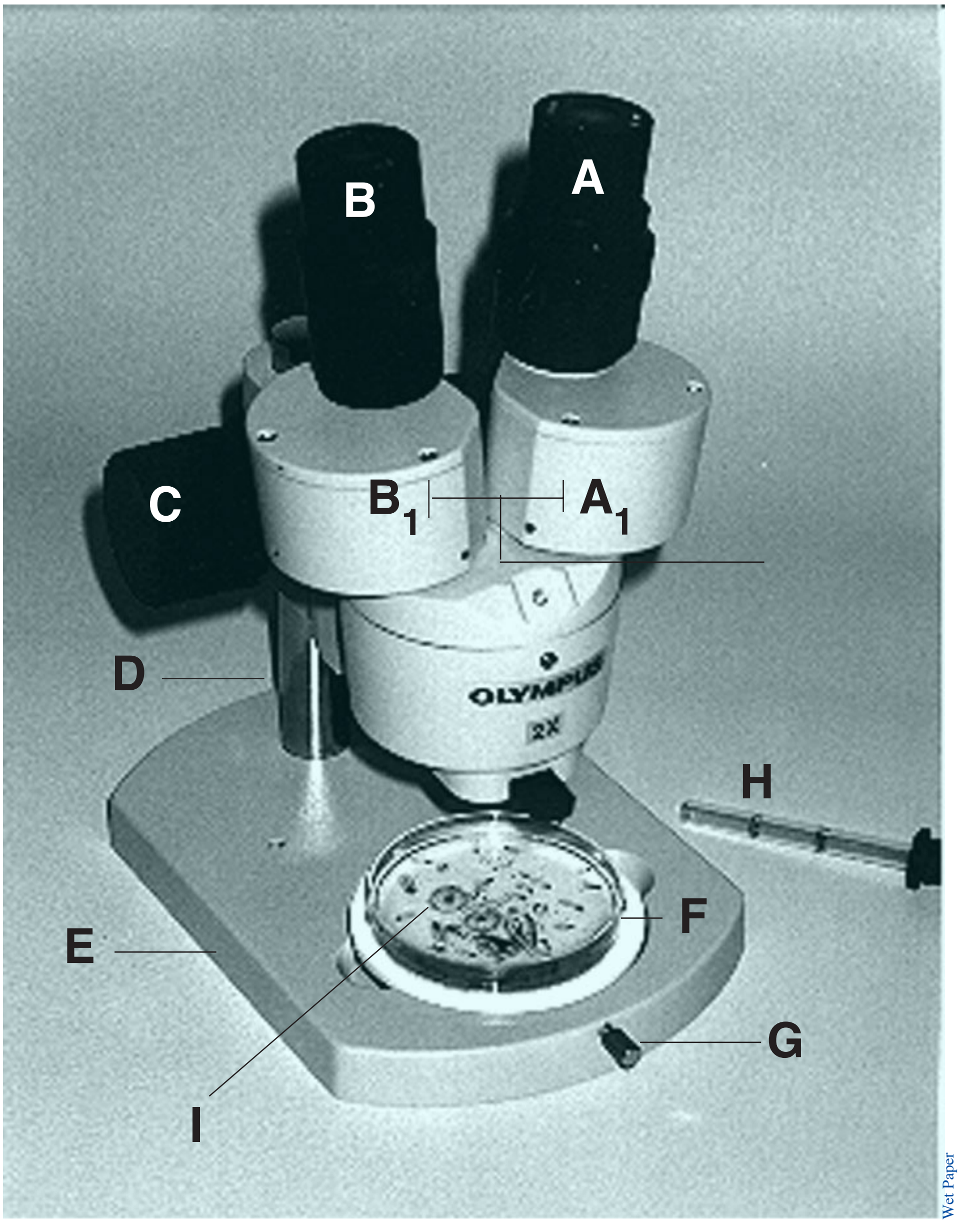


Figure 33.3 Steromicroscope for viewing live plankton

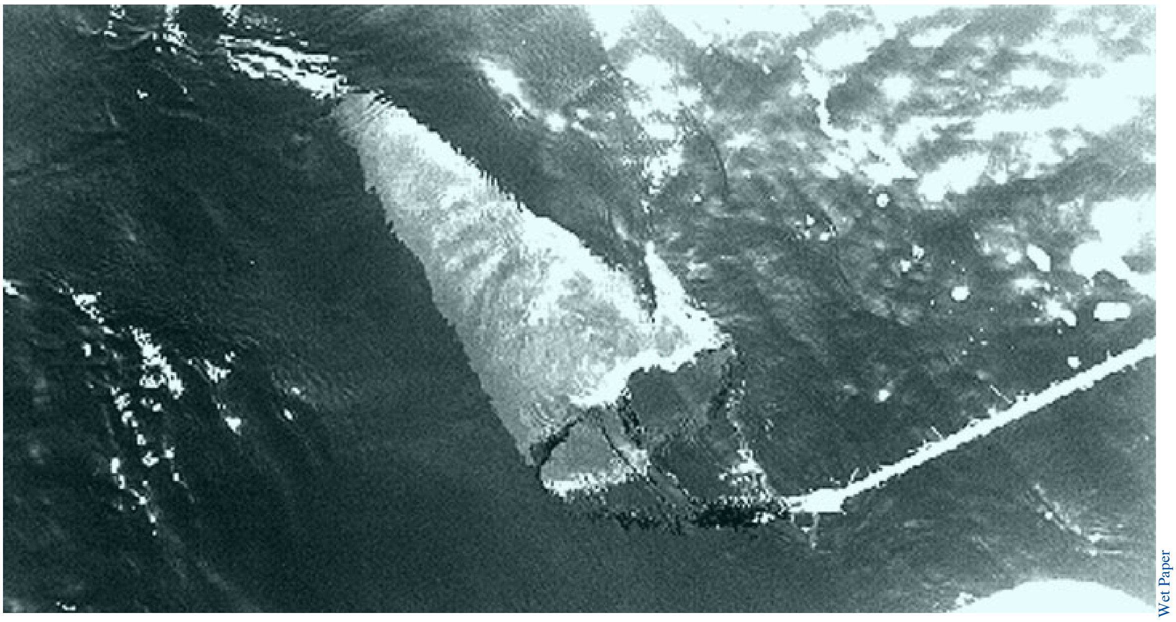


Figure 33.4 Catching plankton

Identifying plankton

The illustrations that follow are from *Plankton of Moreton Bay* by Bernard Cooke, Tony Edwardson, Jack Marsh and David Tulip 1983. (Copyright - reproduced here with permission)

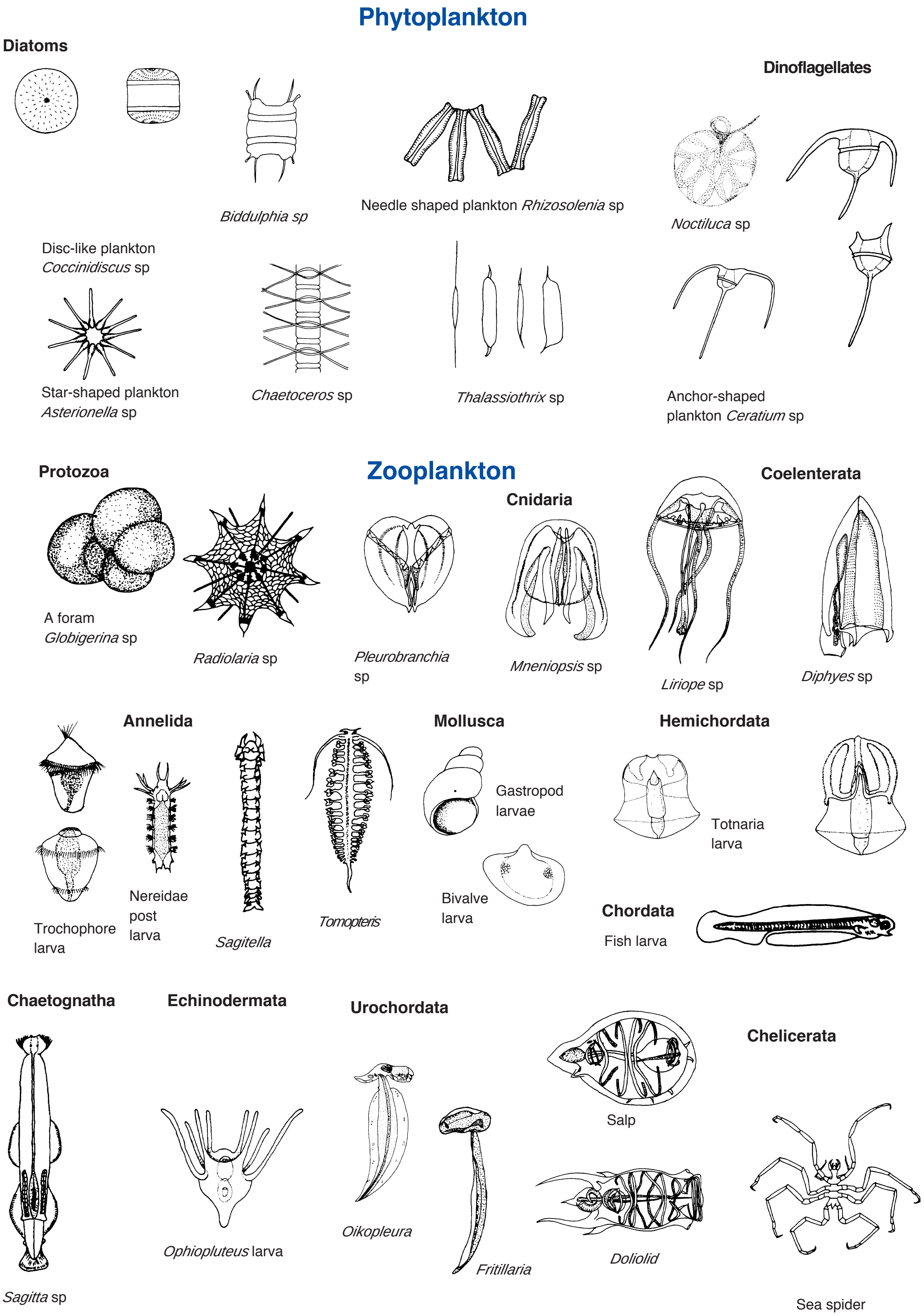


Figure 33.5 Common plankton

Bernard Cooke, Tony Edwardson, Jack Marsh and David Tulip

Zooplankton (cont'd)

Crustacea

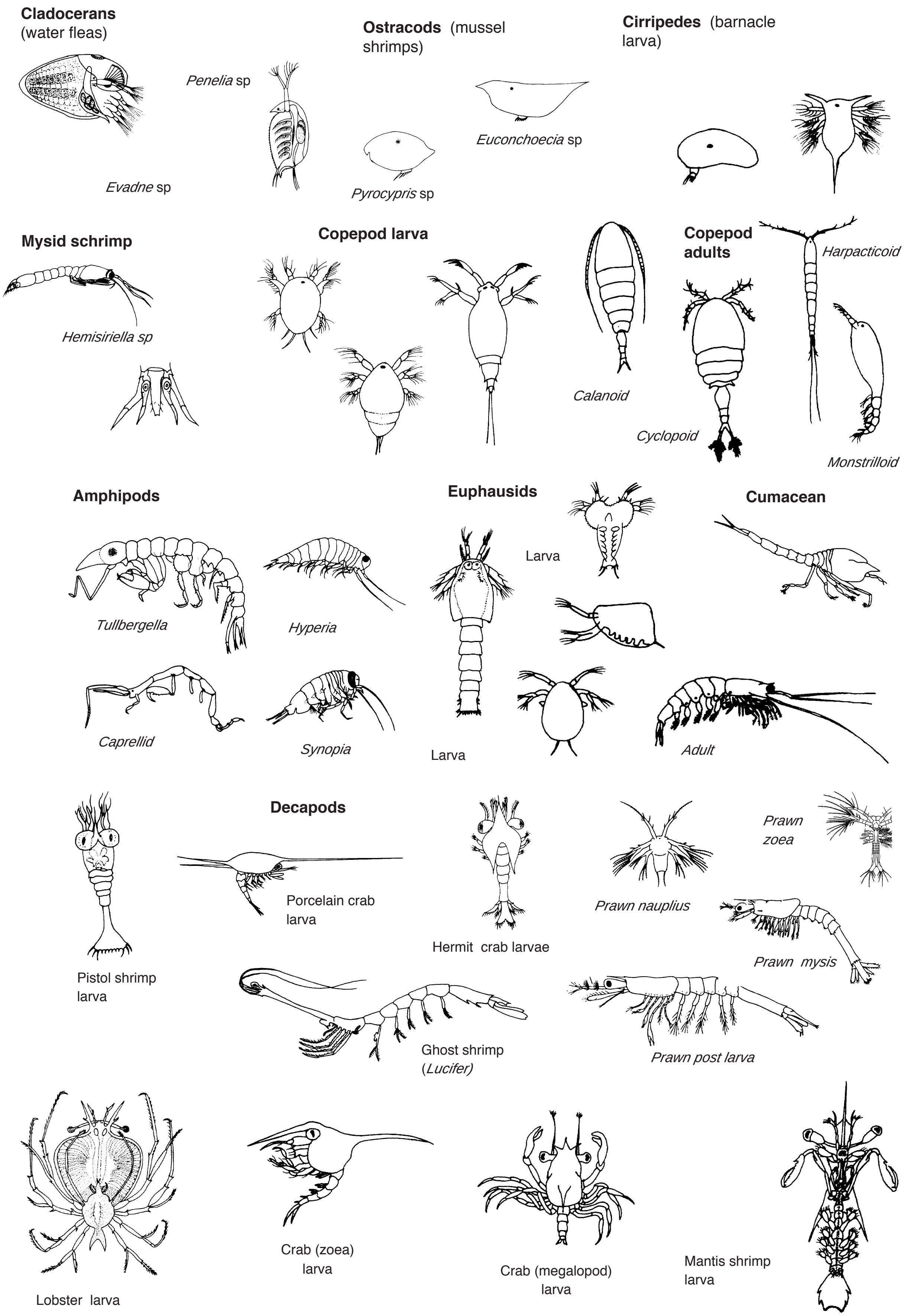


Figure 33.6 Common plankton

Bernard Cooke, Tony Edwardson, Jack Marsh and David Tulip

EXERCISE 34
PLANKTON THREE LEVEL GUIDE

Based on an original exercise by Gwen Connolly, St. Augustine's College

METHOD

1. Read the instructions to the three level guide in Figure 18.1 on Page 42.
2. Now read pages 399 to 404 of your textbook and complete the following:

Level 1 Literal — reading for accuracy

a. For each of the following statements write T (true) or F (false) in the space just after the number.
b. Be able to show where these statements appear in the article.
c. Use P for paragraph and L for line.

1. ____ Plankton are mostly microscopic organisms that wander and drift with the tides and currents.
2. ____ Diatoms and copepod are phytoplankton.
3. ____ A crab was once a temporary plankton member.
4. ____ Water and oxygen combine with light energy in the process of photosynthesis.
5. ____ Dinoflagellates are plants as they contain chlorophyll.
6. ____ The toxin produced by dinoflagellates can be passed on to humans by eating shellfish.
7. ____ Some jellyfish are bioluminescent.
8. Complete the boxes in Figures 34.1 to 34.3.

Level 2 Interpretive — drawing conclusions

1. ____ Phytoplankton that possess a chromatophore are able to photosynthesize.
2. ____ Photosynthesis can only occur in the photic zone.
3. ____ Diatoms reproduce sexually by binary fission.
4. ____ A blue ocean indicates a lot of fish in the area.

Level 3 Applied — defending your opinion

Be able to give reasons (argue) why your answer is correct.

1. ____ The photic zone is the most important zone in the ocean.
2. ____ Diatoms are commercially very important to man.
3. ____ Dinoflagellates are a danger to our waters.

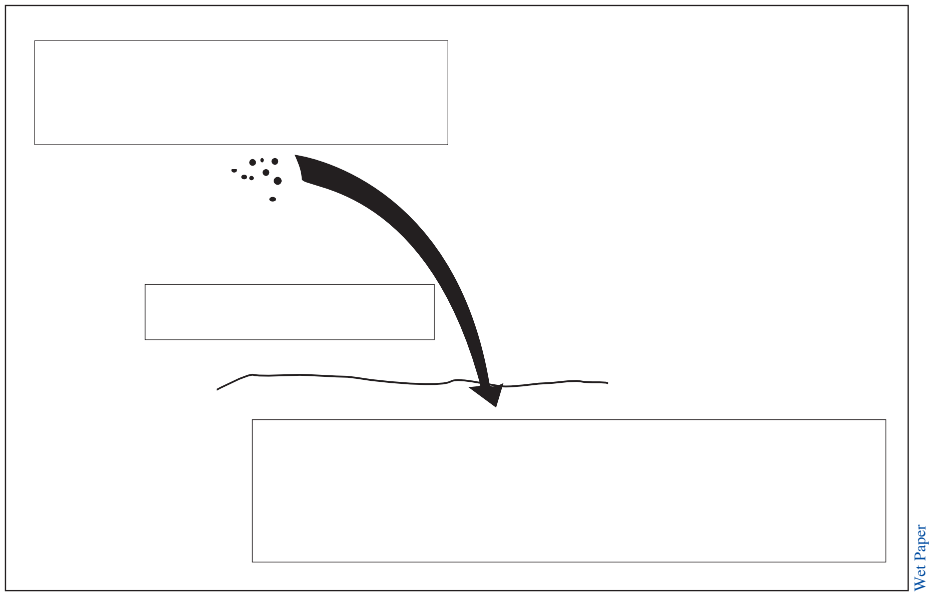


Figure 34.1 Nitrogen fixation

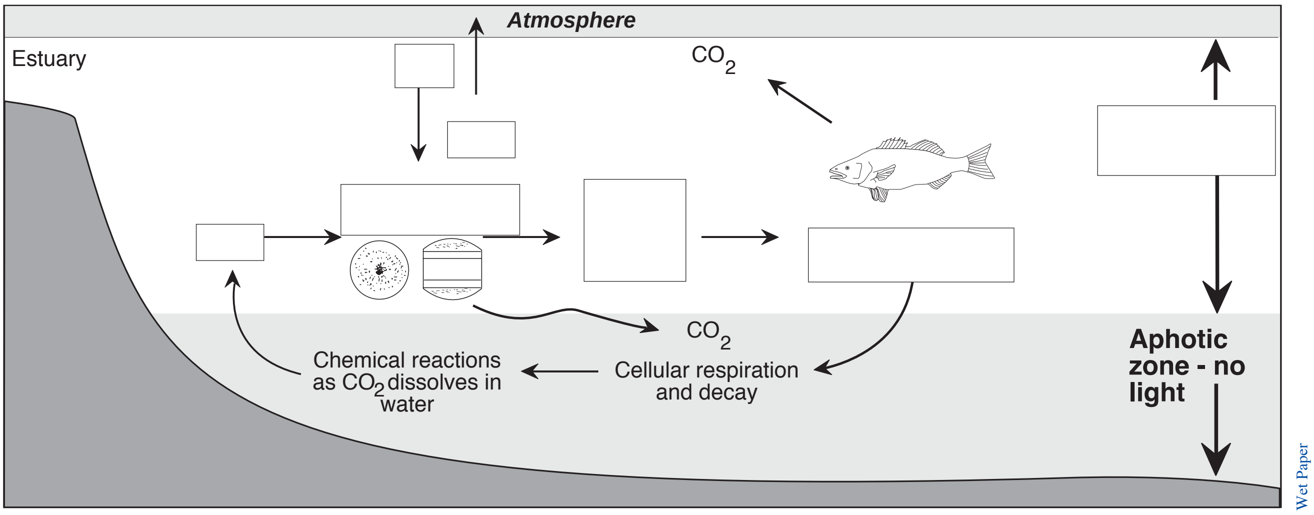


Figure 34.2 Photosynthesis and the photic zone

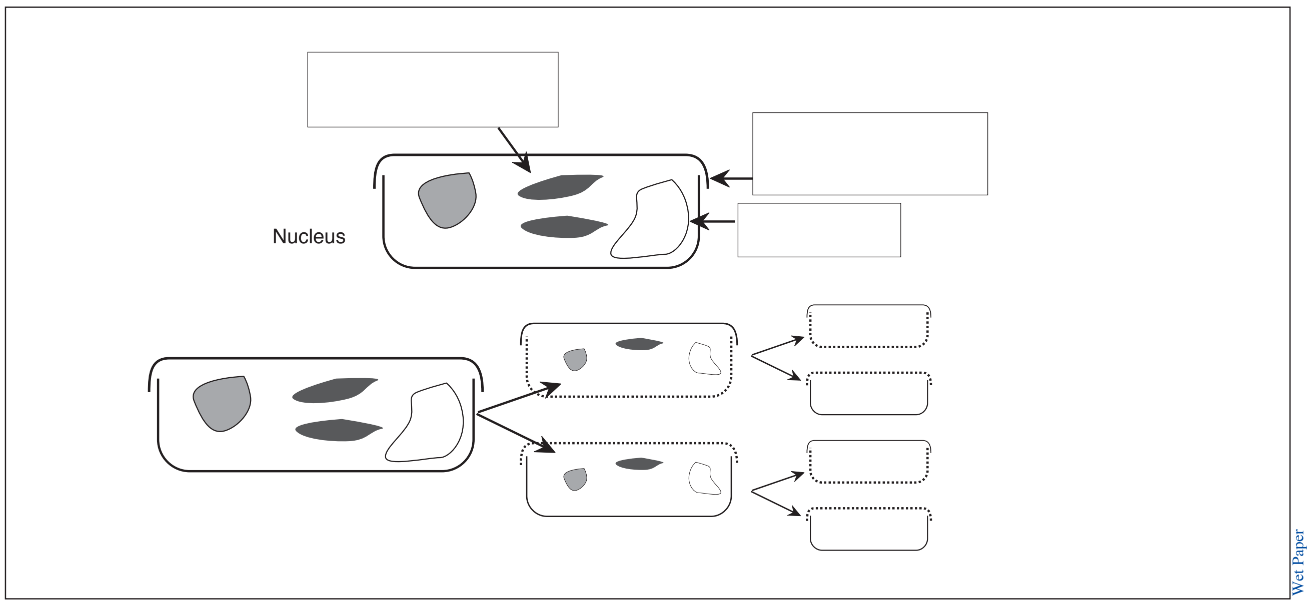


Figure 34.3 Diatom reproduction

Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 35
Life cycles

Based on an original exercise by Tim Ryan, Maryborough State High School

Questions

1. Use your textbook to identify each of the drawings of plankton and adult life forms in Figure 35.1 with the assistance of the list below.
   a. larval stage of a rock lobster
   b. larval stage of a sea urchin called a pluteus
   c. larval stage of a snail called a veliger
   d. larval stage called a zoea
   e. third larval stage of a prawn
   f. first larval stage of crab
   g. second larval stage of a prawn
   h. larval stage called a megalops
   i. fourth larval stage of a prawn
   j. first larval stage of a prawn
2. Now draw these in the spaces provided Figure 35.2.
3. Describe with the aid of drawings the life cycle of a crab.
4. How many stages are in a prawns life cycle?

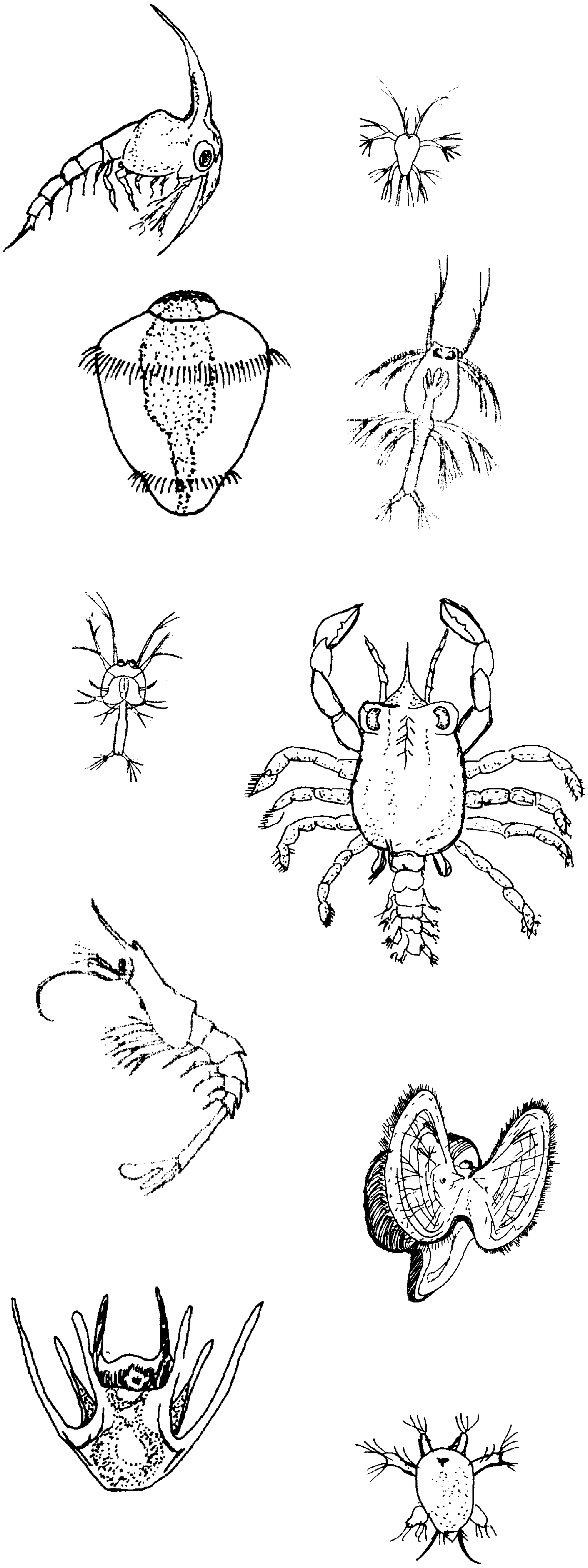


Figure 35.1 Planktonic and adult life forms
Wet Paper

Larval stage	Matching number	Drawing	Larval stage	Matching number	Drawing
First larval stage of a crab			Larval stage of a rock lobster		
Second larval stage of a prawn			Larval stage of a sea urchin called a pluteus		
Larval stage of a crab - megalops			Larval stage of a snail called a veliger		
Fourth larval stage of a prawn			Larval stage called a zoea		
First larval stage of a prawn			Third larval stage of a prawn		

Figure 35.2 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 36
Associations

Based on an original exercise by Tim Ryan, Maryborough State High School

Questions

Complete this exercise after reading pages 492 - 494 of your textbook.

1. Locate the words predator, prey, mutualism, parasitism, commensalism and territoriality to complete Figure 36.4.

2. The term inquilism is used to describe associations that lead to protection.

   Give an example of an association that would demonstrate this term.

3. The term phoresis is used to describe associations for transport.

   Suggest an association where one organism gains transport from another species.

4. Can you find any other relationships involving commensalism in your textbook?

5. The flatworm in Figure 36.1 has a special feeding relationship with a fish. What is it and what is the name of the relationship?

6. What is the relationship between Figures 36.1, 36.2 and 36.3?

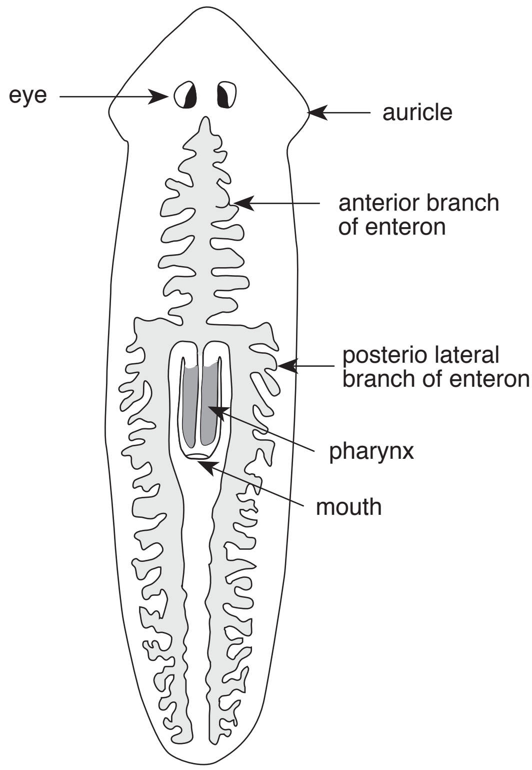


Figure 36.1 A flatworm
Wet Paper

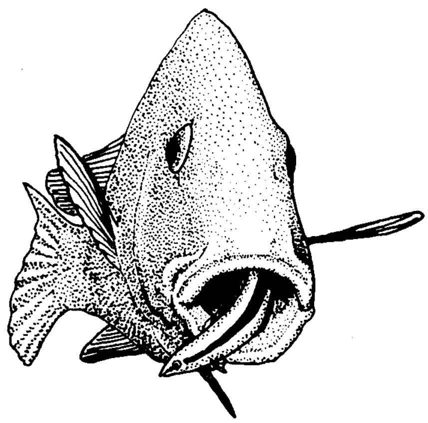


Figure 36.2 Fish and cleaner fish (Illustration courtesy Great Barrier Reef Marine Park Authority - Project Reef Ed)

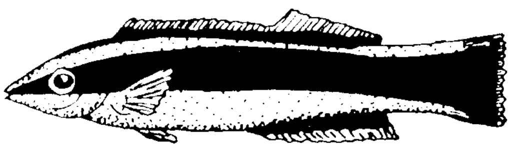


Figure 36.3 Cleaner fish (Illustration courtesy Sea World - Project Neptune)

Associations and interactions			
Organisms	**Name given to association**	**Detrimental or benificial**	**Summary of association**
Tapeworm and barramundi			
Gobi and shrimp			
Clownfish and anemone			
Remora and shark			
Whiting and bream			
Mackeral and garfish			
Parrot fish and coral			
Wrasse and cod			
Clam and algae (Zooxanthellae)			
Barnacle and copepod			

Figure 36.4 Associations and interactions

EXERCISE 37
SPONGES

QUESTIONS

Study Figures 37.1 to 37.6 and answer the questions below.

1. What does the term multi-cellular mean?
2. What is the name of the cells on the outside of the colony?
3. What is special about the cells at the base of the colony?
4, How does water get into a sponge and what is the connection between this and Figure 37.2.
5. What is the name of the chamber in the inside of the sponge?
6. What is the name of the exit point of water from the sponge?
7. What is the main food for sponges?
8. Examine Figure 37.1.
   a. What is this type of cell?
   b. What is its role in the colony?
   c. What are the names of A, B, C and D
   d. How is food eaten by this cell?
9. Figure 37.3 shows two sponge spicules.
   a. How are they formed?
   b. What is their role in the sponge?
   c. They have been referred to as the fingerprints of the sponge. Why has this phrase been used?
10. What is the mesoglea and what function does it serve?
11. Redraw Figure 37.4 in your notebook.
    a. Label A - C with the correct terms.
    b. Guess how this cell will feed.
    c. What role does it play in the life of the sponge?
12. Redraw Figure 37.5 in your note pad. Now use arrows to show how water circulates around the sponge.
13. Where are sponges found?
14. How do you think they reproduce?
15. What role do you think sponges play in the bio-diversity of benthic life?

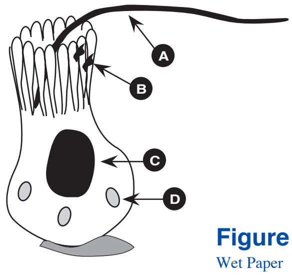


Figure 37.1
Wet Paper

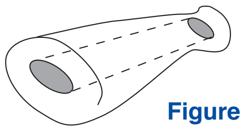


Figure 37.2
Wet Paper

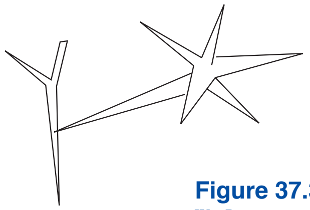


Figure 37.3
Wet Paper

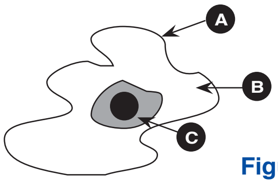


Figure 37.4
Wet Paper

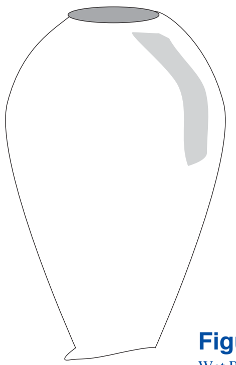
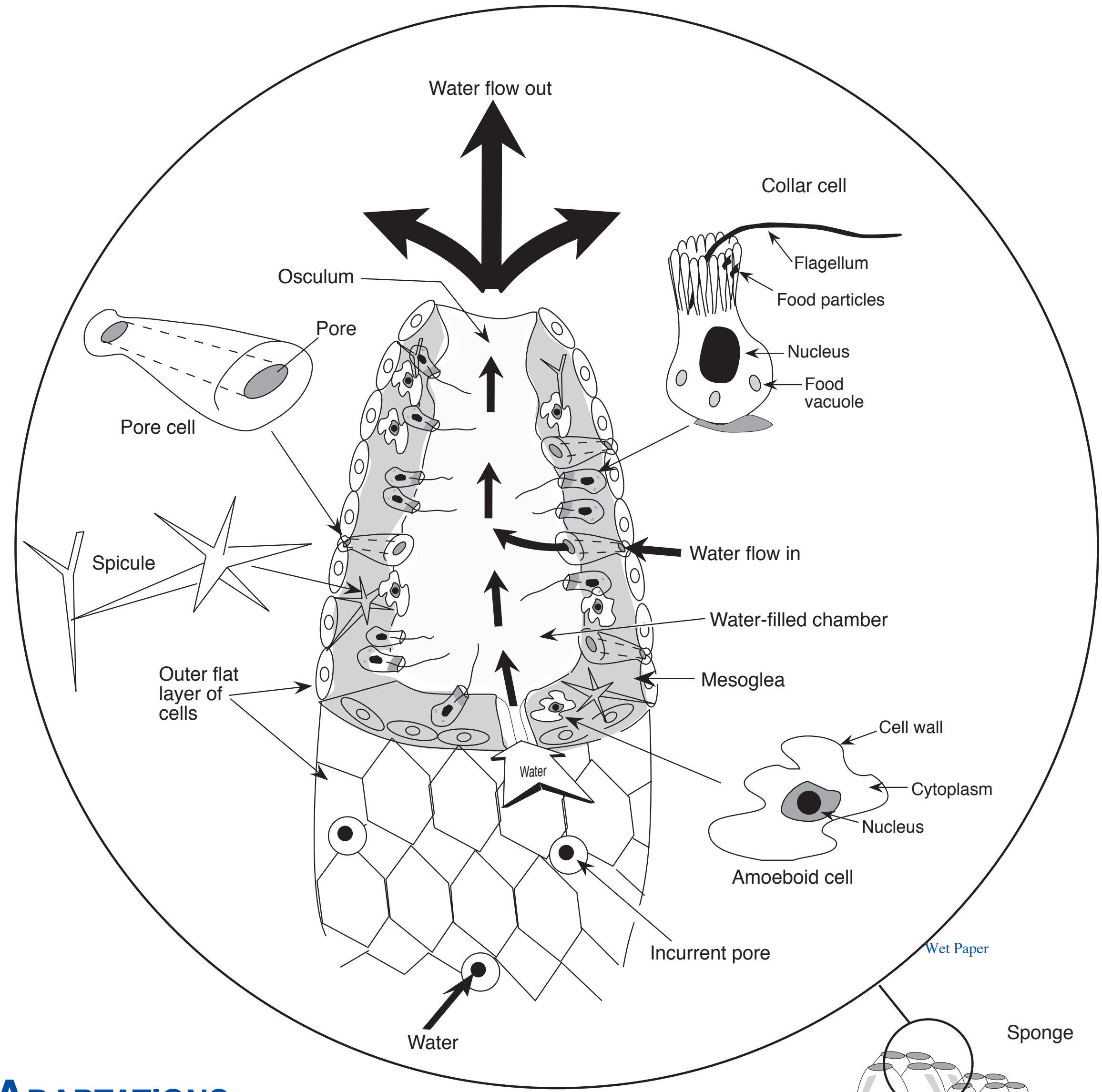


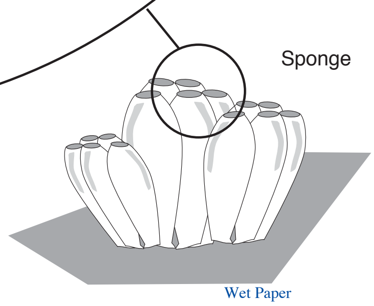
Figure 37.5
Wet Paper

MATERIALS AND EQUIPMENT (PER GROUP)

Equipment required

- stero-microscope
- sponge
- petri dish





Adaptations

Sponges are characterised by having many pores, no definite body symmetry and lack organs and tissues.

They are the simplest form of multi-cellular animals. They are composed of a number of different types of cells that are held together by a jellylike substance called mesoglea and by silica .

Outside layer of cells

On the outside of the colony are the flat cells, which give the animal its shape. The flat cells at the bottom of some sponges secrete a sticky substance to anchor the sponge in place.

The outside layer of the animal is dotted in many places by an incurrent pore cell. This allows water to flow in and pass out through a hole in the top of the animal called an osculum.

Water passing through an inner water filled chamber bathes a number of specialized cells, two of which are the amoeboid and collar cells.

Food

Bacteria, small fragments of other animals, dinoflagellates and small plankton compose the main food of the animal are caught by the whip like flagella of the collar cells. This food is ingested or eaten by other wandering amoeboid cells.

Strength

The amoeboid cells are capable of developing into a number of different cell types, one of which is capable of secreting silica. These cells are called spicules which strengthen the outer cell wall and are characteristic to each type of sponge. Some scientists call them the sponge's fingerprint because the spicules can be used to distinguish between different species of sponge.

Figure 37.6 Adaptations (Diagram after Lerman, 1985)

Exercise 38 Adaptations of plankton

Based on an original exercise by Tim Ryan, Maryborough State High School

Questions

Read pages 399 - 410 of your textbook and then answer the following questions.

1. Complete table 38.4 by:
   a. Drawing a sketch of the animal in column 1 from the information supplied.
   b. Writing the name of the animal from column 1 in column 2.
   c. Classifying the plankton as either permanent or temporary; zooplankton or phytoplankton, by placing a tick in either columns 3, 4, 5 or 6.
   d. Writing the function or survival benefit of the named structure from column 7 in column 8.
2. Look at Figure 38.1 and name three structural adaptations to its life as a planktonic individual.
3. Figure 38.2 shows special adaptations to jellyfish. Use your textbook to find out what these are and make a description of how the various cells work.
4. Figure 38.3 shows a planktonic animal called "by the wind sailor". How do you think it got its name and what structural adaptations assists its planktonic existence?

Figure 38.1 A sea jelly
Wet Paper

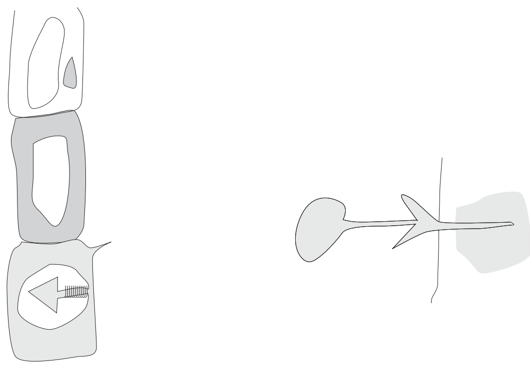


Figure 38.2 Jellyfish adaptations
Wet Paper

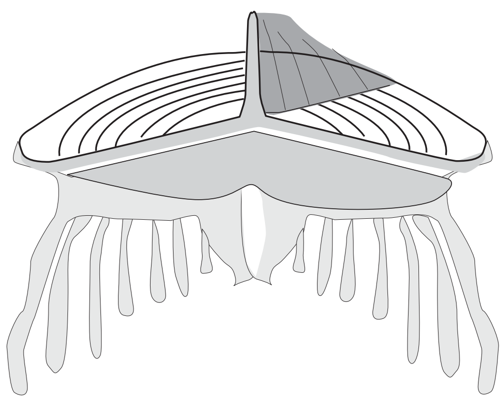


Figure 38.3 By the wind sailor
Wet Paper

Adaptations of plankton							
1 Sketch	2 Name	3 Permanent	4 Temporary	5 Phytoplankton	6 Zooplankton	7 Structure	8 Function/survival benefit
Figure 3 P 400						Projections from body	
Figure 8 P 400						Flagellum	
Figure 15 P 405 Copepod						Eye spot, no digestive system	
Figure 15 P 405 Lucifer						Appendages	
Figure 15 P 405 Comb Jellyfish						Hair and shape	
	Medusa stage of jellyfish					Statocysts and bell shape	
Figure 6 P 401						Air filled sac and chromatophore	
	Nauplius larvae					Appendages	

Figure 38.4 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 39
Anemones and corals

Questions

1. Use your textbook to complete the answers in Figure 39.3
2. Figure 39.1 shows a special type of body plan. What is this plan called and to what group of animals is it common.
3. Redraw and complete the table in Figure 39.2 and then write a paragraph on how corals reproduce.

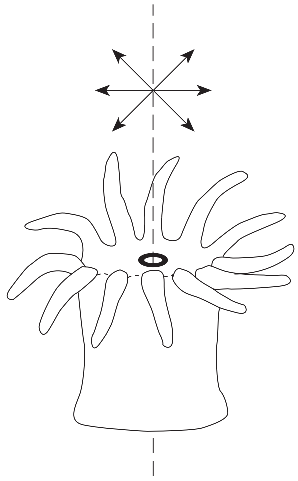
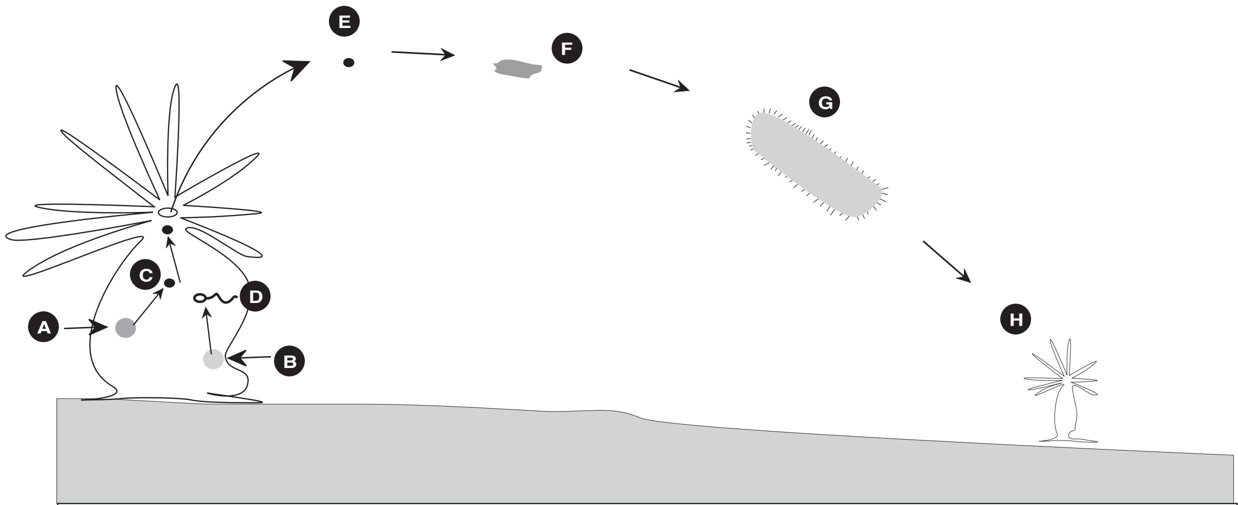


Figure 39.1 Body plan of an anemone
Wet Paper



Column A - names of reproductive parts or events	Column B - matching letters in illustration above
1. Zygotes	
2. Planula larva	
3. Egg bundle	
4. Eggs	
5. Sperm	
6. Ovary	
7. Testis	
8. Juvenile polyp	

Wet Paper

Figure 39.2 Reproductive cycle of a coral

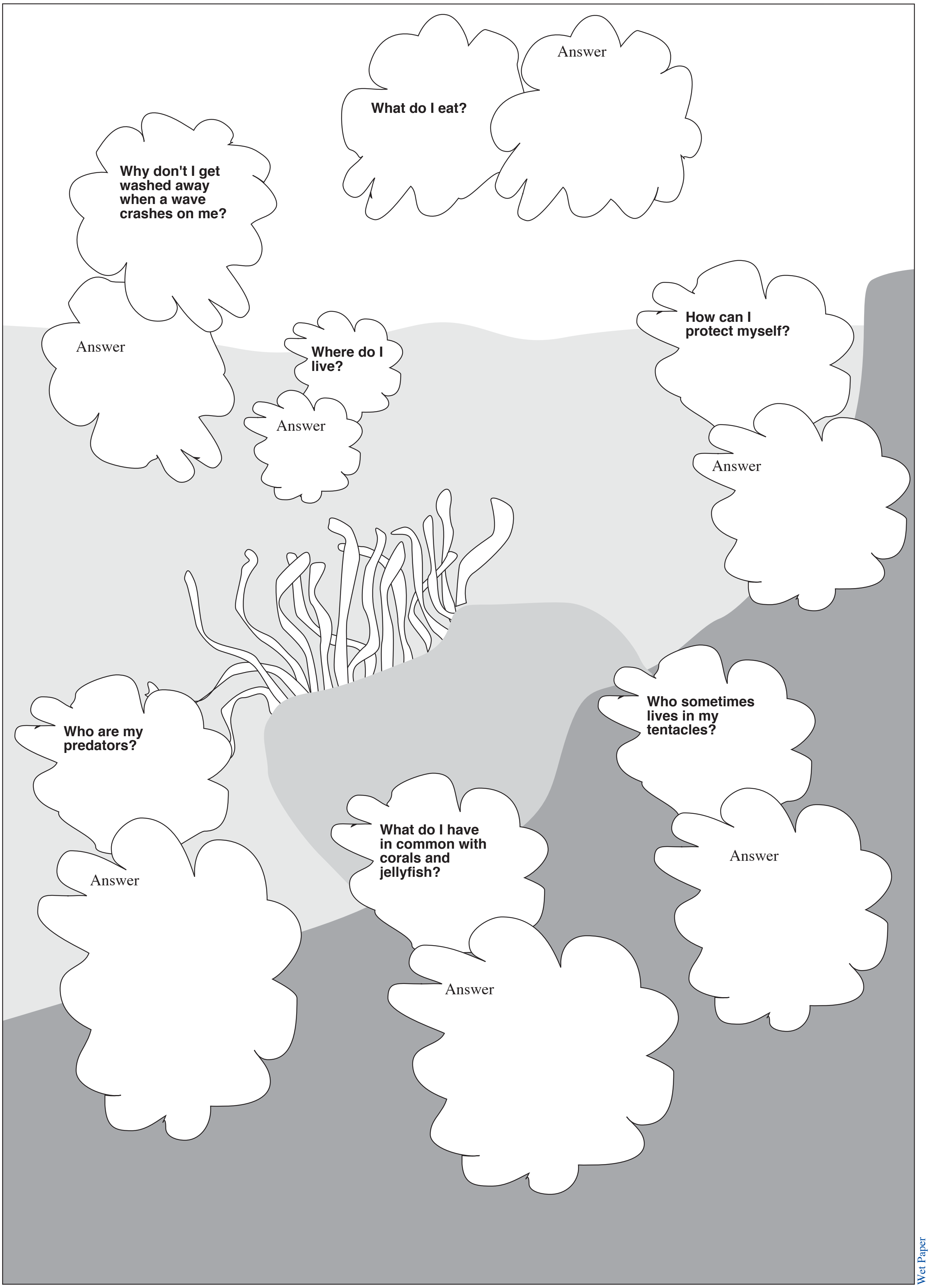


Figure 39.3 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 40
Fish dissection

Method

Refer back to Figures 23 and 24 Pages 431 and 432 of your textbook before beginning this exercise.

Part A - External features

1. Use your reference book to identify your fish (scientific name, notable characteristics, colour, size etc.)
2. External anatomy - using the diagram of the external parts of fish, locate the following:
   - spiny dorsal fin (if present)
   - pectoral fin
   - soft dorsal fin
   - nostrils
   - caudal fin or tail, scales
   - ventral fin (pelvic)
   - operculum or gill cover
   - gills (look under operculum)
   - gill rakers
3. Use your textbook to help you identify the parts labelled A to K in Figure 40.3 on your fish.

   Make a detailed drawing of your fish in the space provided in Figure 40.3.
4. Open the fish's mouth and look down the throat to examine the structures shown in Figure 40.4.

   Make a careful study of the fish's gill system and use your textbook to write a description of how your fish gets oxygen into its blood.

   Use the letters A to F in Figure 40.4 to illustrate your answer.

Materials and equipment (per group)

- dissection board or tray
- sharp knife
- dissecting kit (scalpel, scissors, probe)
- local fish
- fish scaler
- steromicroscope
- coloured pieces of wool
- reference book

Figure 40.1 First you need to catch your fish (Photo courtesy Geoff Jensen)

5. Read the boxed information in Figure 40.5 on fish scales and take a sample scale and examine it under the microscope.

   Make a careful drawing in Figure 40.3 and see if you can age your fish from the information given.

Part B - Internal anatomy

1. Lay the fish out on your dissecting board.
2. With a sharp knife make a horizontal cut from the operculum to the caudal fin (down the centre of the fish - 1st cut) as shown in Figure 40.2.
3. Make vertical cuts at the operculum, above and below the 1st cut (2nd cut).
4. Make vertical cuts near the caudal fin, above and below the 1st cut (3rd cut).
5. Peel back the flaps of skin; the internal organs should now be exposed.
6. Using the illustration in Figure 40.7, identify the following internal structures by using the coloured wool supplied. Make up a colour key to show your partner the piece of coloured wool which represents an organ or structure.
   - heart
   - backbone
   - stomach
   - muscles
   - liver
   - larynx
   - kidney
   - phlorus
   - air bladder
   - anus
   - gills
   - urinary bladder
   - intestines

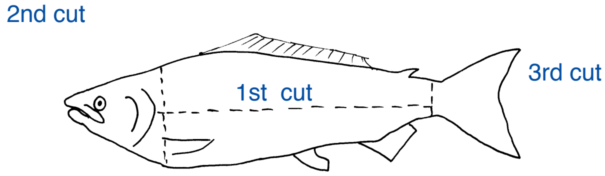
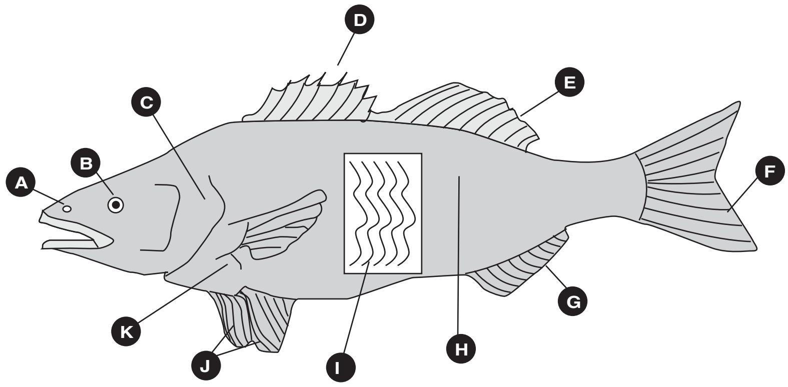


Figure 40.2 Where to cut the fish
Wet Paper

Your sketch



Wet Paper

Figure 40.3 General external features of your fish. Students may make one copy of this page so that they can attach their answers before handing in for marking.

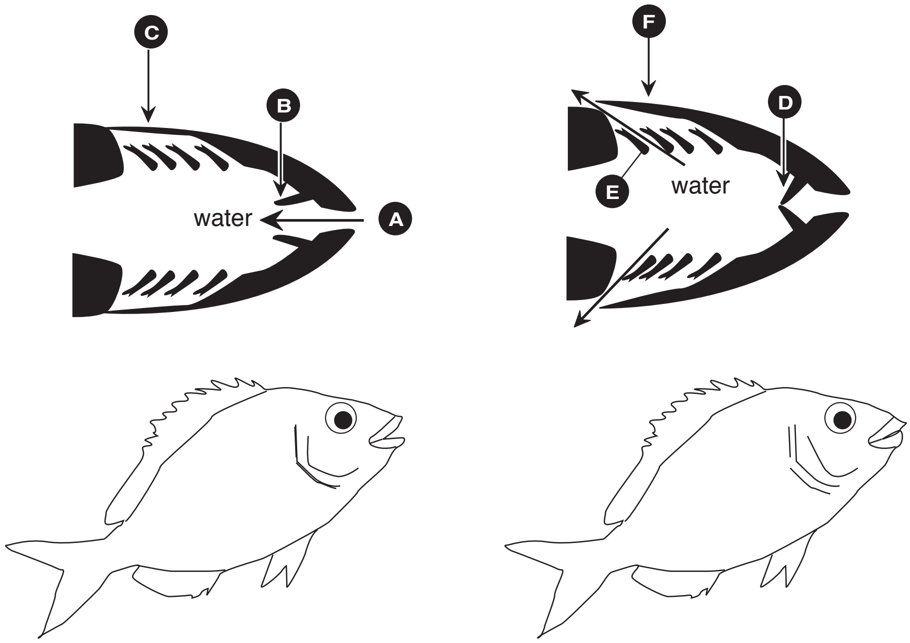


Figure 40.4 How a fish uses water to extract oxygen for the blood stream
Wet Paper

Age determination of fish

The purpose of this activity is to determine the age of a fish by counting scale rings. To the fishery biologist, the fish scale represents a valuable tool in the investigative process.

The biologist can choose to use the scale to determine the age of the fish. This information can be used as an interpretation on the life history of some fish. In addition, scientists use scales in the identification and classification of fish.

It should be mentioned, however, that not all fish have scales, and those having scales do not all have the same type. Scales are not exclusive to fish. The more primitive forms of fish have placoid scales. (Use reference books to find these). This is a scale possessing a dense enamel and dentine layer. Other fish scales are non-placoid types, having no enamel or dentine.

There are three types of non-placiod scales.

a. the cosmoid type scale found in all lung fish of the world.

b. the second type scale is the tile-like arranged ganoid scale found in gars and reed fish.

c. the third type is the bony-ridge scale. Typically, they are thin and translucent.

Having identified all these features, take a scale and a steromicroscope or monocular microscope and age the fish. You may like to refer to your textbook Page 429 Figure 19.

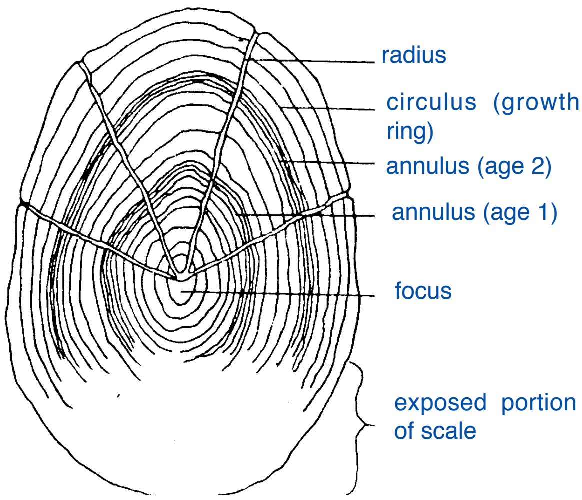


Figure 40.5 Age determination of fish
Wet Paper

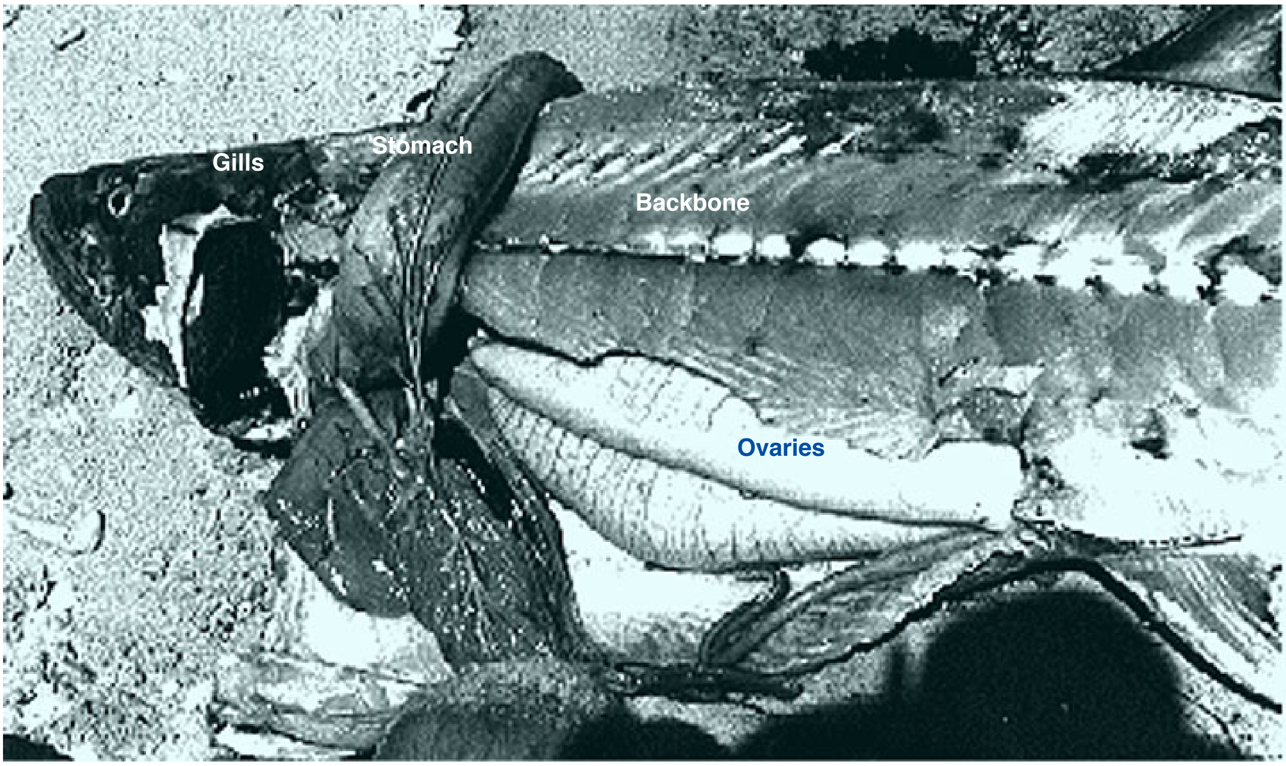


Figure 40.6 Fish dissected laterally (Photo courtesy Geoff Jensen)

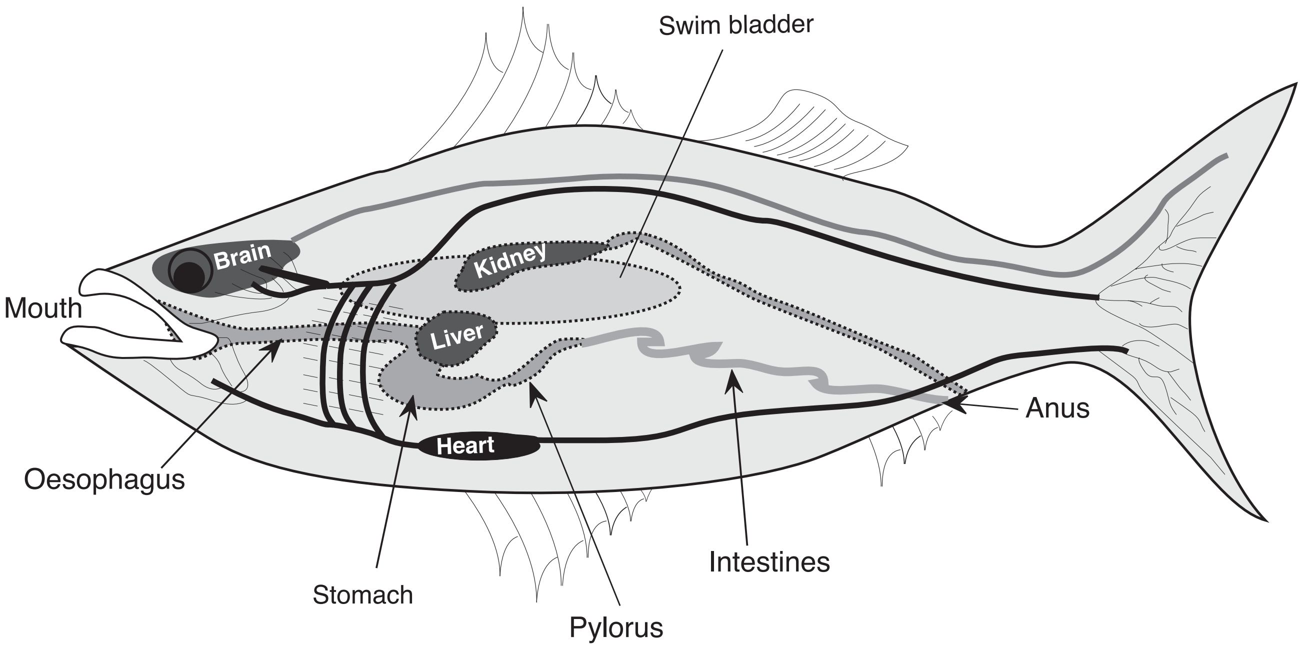


Figure 40.7 General internal features of your fish.
Wet Paper

Exercise 41 Sharks and rays

Questions

Turn to page 427 to answer the following questions on sharks and rays.

1. What is the difference between sharks and rays?
2. Use your textbook to mark in the following external features in Figure 41.1:
   - nostril
   - lateral line
   - gill slits
   - first and second dorsal fins
   - caudal, anal, pectoral and pelvic fins
   - eye and spiracle
3. Use your textbook to mark in the following external features in Figure 41.2:
   - spiracle and nostril
   - mouth, gill slits and flap
   - clasper
   - tail and barb
4. In Figure 41.2, which letter refers to the dorsal side and which letter refers to the ventral side?
5. Why is the mouth on the ventral surface in both sharks and rays?
6. What is the skeleton of sharks and rays made of?
7. Describe how a shark "breathes".
8. What are air bladders? Do sharks have them? If not, what do sharks do to stay afloat?
9. How do sharks mate and is fertilization internal or external?
10. Study Figure 41.3. What is shown in the diagram, and what are the anatomical features labelled C and D?
11. Why are sharks teeth special?
12. Use your textbook to write a paragraph on how sharks find food.

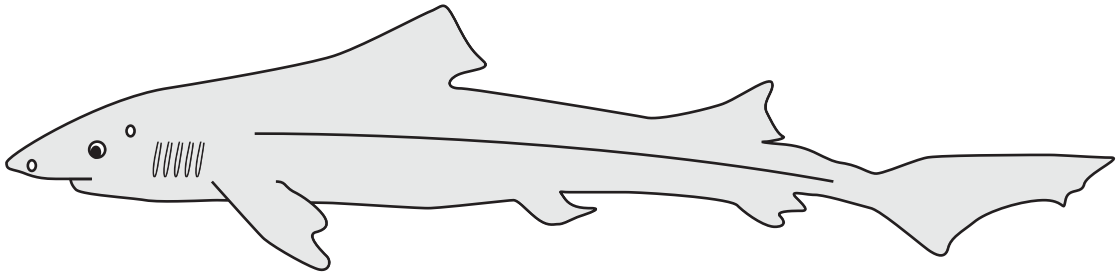


Figure 41.1 Generalised shark
Wet Paper

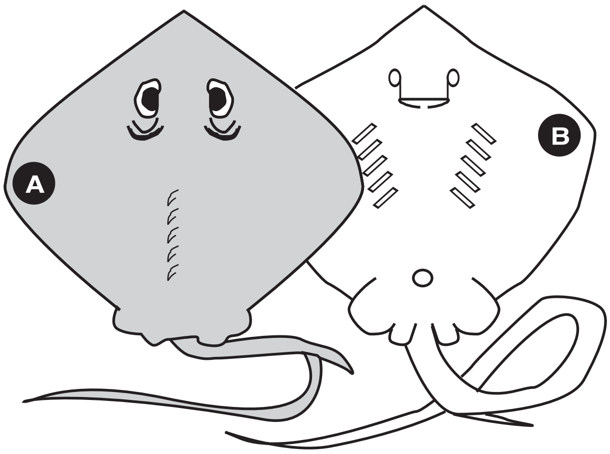


Figure 41.2 Dorsal and ventral views of a ray
Wet Paper

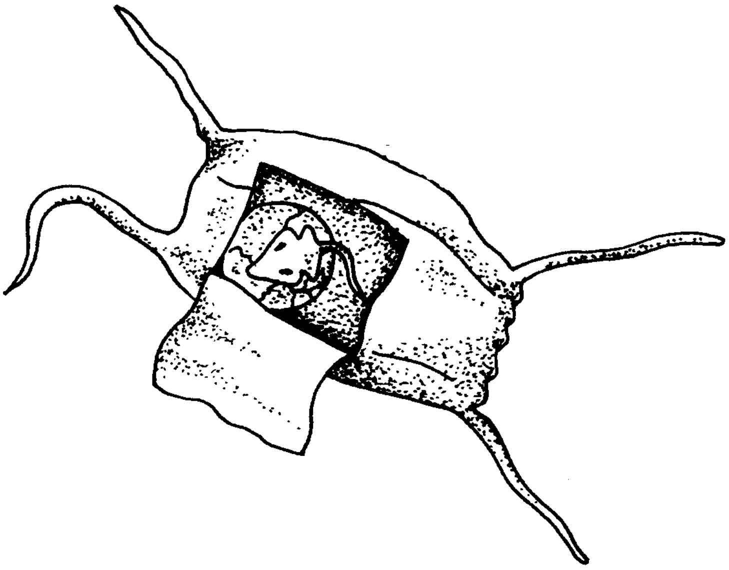


Figure 41.3 Shark development
Wet Paper

Exercise 42
The importance of mangroves

Questions

Use your copy of *Mangroves in Focus* to answer the following questions.

1. From which plant has the seed and leaf shown in Figure 42.1 come from?
2. From which mangrove species shown in Figure 42.2 do the parts A to E come?
3. Use page 525 of your textbook to identify the structures labelled 1 - 6 in Figure 42.3 and describe what happens at the places labelled A - C.
4. Mark on Figure 42.3 where the following occur:
   - anchor roots
   - knee roots
   - cable roots
   - prop roots

Video

Obtain a copy of the video Australia Naturally – Estuaries and Mangroves and fast forward to the place that discusses mangroves. Watch the segment on mangroves and write down six points on the importance of mangroves.

Research project

1. Use *Mangroves in Focus* (Page 109 Figure 4.43) to trace the primary, secondary, tertiary and quaternary effects of chopping down mangroves to build a canal development.
2. Now use this information to complete Figure 42.4 opposite. You will have to redraw the table and undertake the research at a local canal or marina development.

Materials required

- copy of *Mangroves in Focus* by Burnett and Claridge, Wet Paper Publications 14 Milbong Tce Ashmore 4214
- copy of *Australia Naturally – Estuaries and Mangroves*
  Available from:
  Bob Hardie
  PO Box 200
  North Tamborine 4274

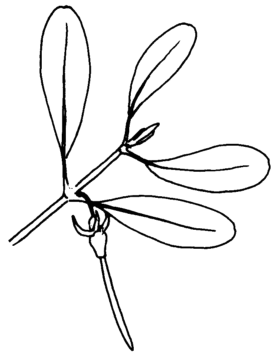


Figure 42.1 Seed and leaf
Wet Paper

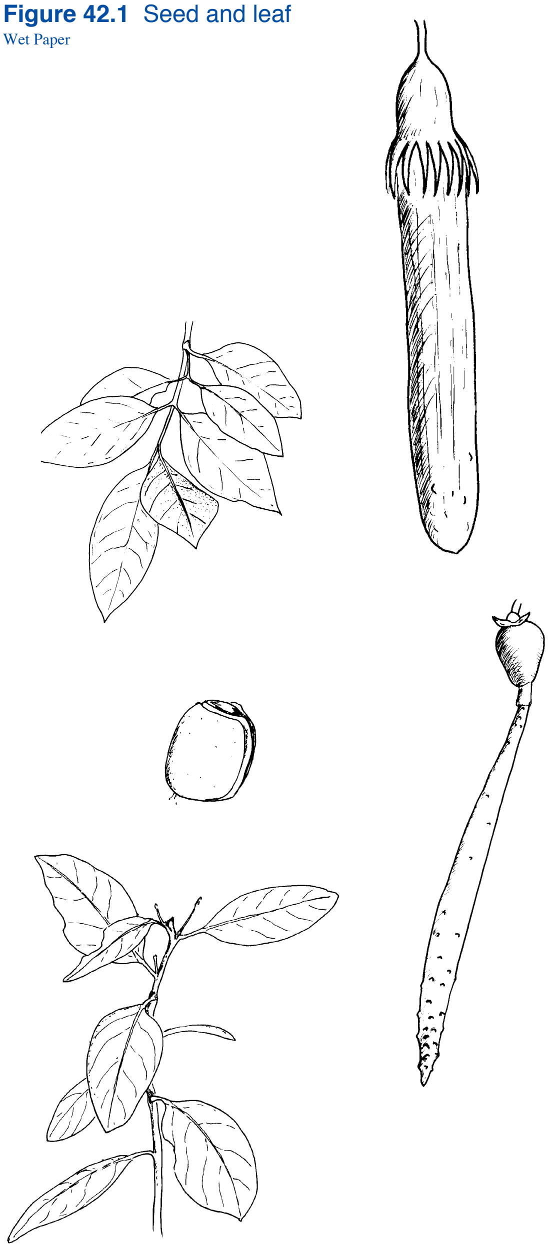


Figure 42.2 Common mangrove parts
Wet Paper

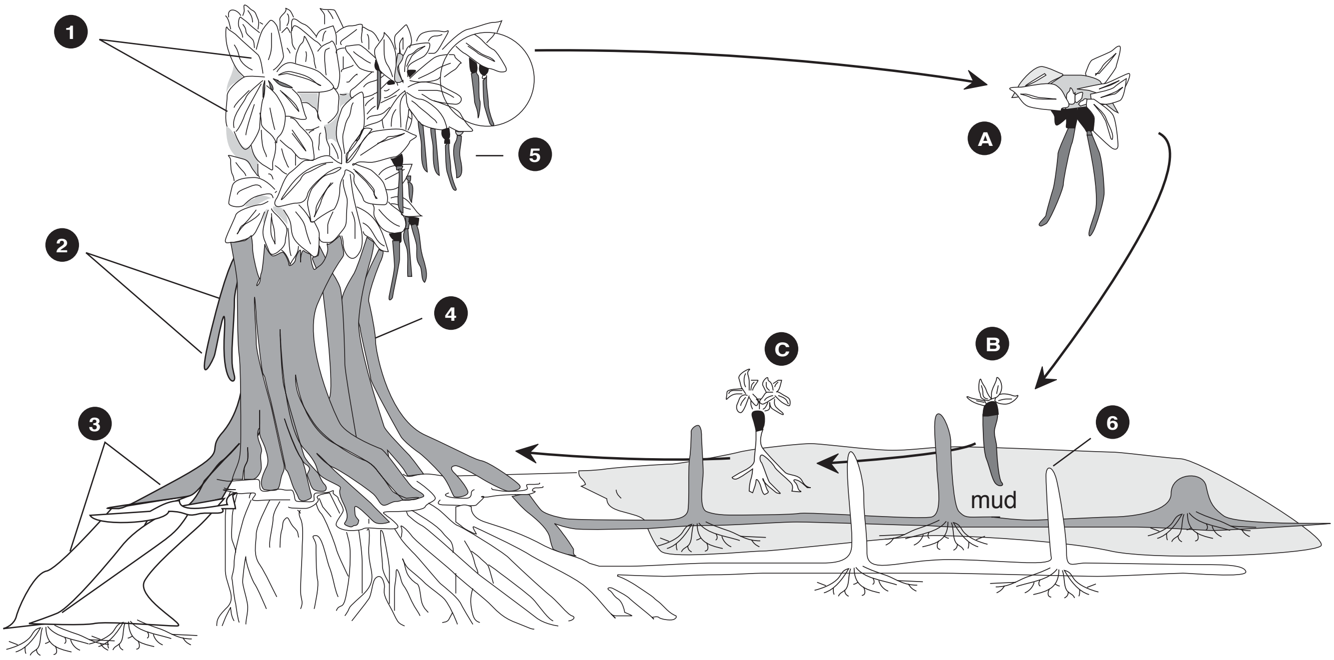


Figure 42.3 Mangrove life cycle (Lerman)
Wet Paper

Development / Consequence chart										
1. Establishment of canals										
2. Mangrove destruction										
3. Dredging of waterways										

Wet Paper

Figure 42.4 Students may make one copy of this page so that they can attach their answers before handing in for marking.
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Exercise 43
Seagrasses

Questions

1. Study Figure 43.1 and write a paragraph explaining what seagrasses are.
2. Look carefully at Figure 43.2. What types of animals would the Ibis be eating?
3. How has the silt accumulated in the creek? What role have seagrasses played in this?
4. What types of animals would feed on seagrasses at high tide?
5. Seagrasses are susceptible to nitrate and phosphate pollution from land. What effect would these fertilizers have on the microalgae associated with the seagrass beds?
6. Write for the brochure on Seagrasses from the Great Barrier Reef Marine Park Authority.

   Contact address:
   Seagrass brochure
   Great Barrier Reef Marine Park Authority
   PO Box 1379
   Townsville Q 4680

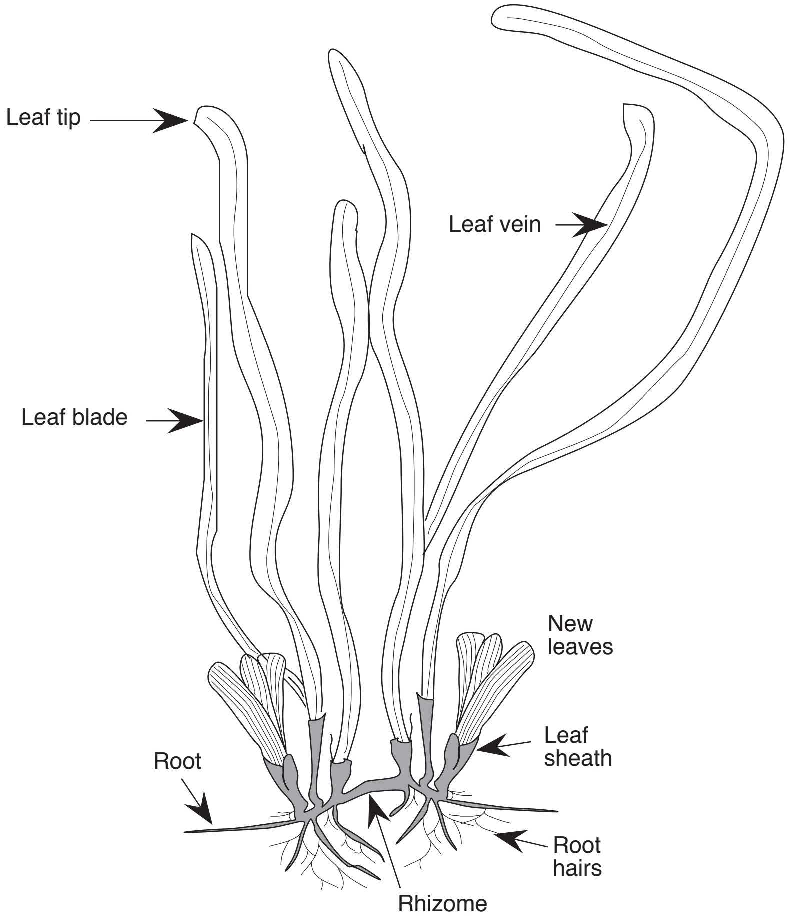


Figure 43.1 Schematic diagram of seagrass
Wet Paper

Figure 43.2 Seagrass bed (Photo Tom Alletson)

Exercise 44 Mangrove transect

Adapted from Activity 50, in Mangroves in Focus by Claridge and Burnett Wet Paper 1993.

Method

Study an area of mangroves to become familiar with:

a. The different types of mangroves

b. Their different adaptations to the hostile intertidal environment

c. Their importance

- as a habitat for other organisms
- in providing a nursery for many aquatic animals
- in stopping erosion and extending the land
- as a buffer zone

d. The different requirements of various species

A mangrove study should be conducted from the low tide mark to the extreme high tide level. Quadrat studies will be done at various points.

The study can be conducted in a variety of ways. One successful method is to employ quadrat studies along a transect line.

If zonation of mangroves is important to the study then the site of the transect line must be chosen with care. Zonation tends to loosely follow height above mean sea level since various species prefer varying degrees of inundation.

Some species, e.g. grey mangrove, show wide distribution while others e.g. milky mangroves or orange mangroves prefer slightly higher ground. If the transect line is chosen with care, some degree of zonation should be apparent.

Reference book

Mangroves in Focus, by Burnett and Claridge, 1993. Available from:

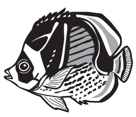
Wet Paper Publications

14 Milbong Tce

Ashmore 4214

Telephone (07) 55 972806

Fascimile (07) 55 394187



Study site

1. At each quadrat make observations and take measurements to complete Figure 44.1. Identify the mangrove species using the keys in the reference book provided.
2. The distance between the 10 m quadrats is arbitrary and will vary with site conditions, slope, etc. Space the quadrats so that you fit at least five into the intertidal zone.
3. Some of the questions in the following column would be more successfully completed as research questions after returning to school.
4. Map out 10 metre square quadrats at various points (every 30 m) along the transect line.
5. Draw a plan view of each quadrat on your notepad. Draw a simplified profile of the transect line showing any zonation of mangroves that is evident. Use a key to represent the various species.
6. Collect information on organisms present and draw a food web of the transect site.

Questions

1. It should be evident from your field study that mangroves have very large, well developed root systems. What are the two main reasons for this?
2. Mangroves live in salt water. Salt is a toxic substance to most plants and if it was allowed to build up to a large amount inside the mangrove tree it would prove fatal. Outline the various ways mangroves reduce the amount of salt present inside the tree.
3. Mangroves also face problems when reproducing. The intertidal environment, with the tide washing in and out twice a day, makes it difficult for seeds to gain a hold in the mud without getting washed away. Outline the various ways mangroves cope with this problem.
4. Many areas of mangroves have been destroyed to make way for housing, canal developments, marinas, improved views, etc. We now realise that mangroves are very important areas and that they should be preserved and protected. Outline the reasons why mangroves are so important.

Variable	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5
Height above low tide mark (m)					
Wind direction N,N/E etc					
Wind speed km/hr					
Air temperature ^oC					
Mud temperature ^oC					
Relative humidity %					
Mud composition					
Mud salinity					
Mud pH					
Light intensity (canopy)					
Light intensity (ground level)					
Ground cover %					
Animals present					
Mangrove species present					
Other plant species					

Figure 44.1 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 45
Mangrove life cycles

Permit required

In most Australian States you need a permit to collect mangrove leaves.

Your local Department of Environment can help.

In Queensland contact the Department of Primary Industries.

Method

1. Study the mangrove flowers under the steromicroscope and identify the parts of the flower as shown in Figure 45.1 and 45.2
2. Identify the various seeds as shown in Figure 45.3 and make drawings of your mangrove species using the reference book listed below.

Debris collection

Make funnel nets of fine mesh that are one metre square, and set them up above the high tide mark, so that they can catch leaves, flowers and fruit that fall from the trees.

The nets can be used to calculate the weight of the biomass of an area for a day, week, month or year.

Analysis

1. Calculate the weight of biomass in the area per square metre.
2. Which species of mangrove has the greatest fall?
3. Which mangrove species produces the greatest amount of biomass by weight?
4. Calculate the percentage of each type of biomass, e.g. leaves, flowers and bark.

Materials and equipment (per group)

- preserved mangrove flowers
- steromicroscope
- mangrove seeds (see note above)
- reference book:

  Mangroves in Focus, by Burnett and Claridge, 1993. Available from:
  Wet Paper Publications
  14 Milbong Tce
  Ashmore 4214
  Telephone (07) 55 972806
  Fascimile (07) 55 394187

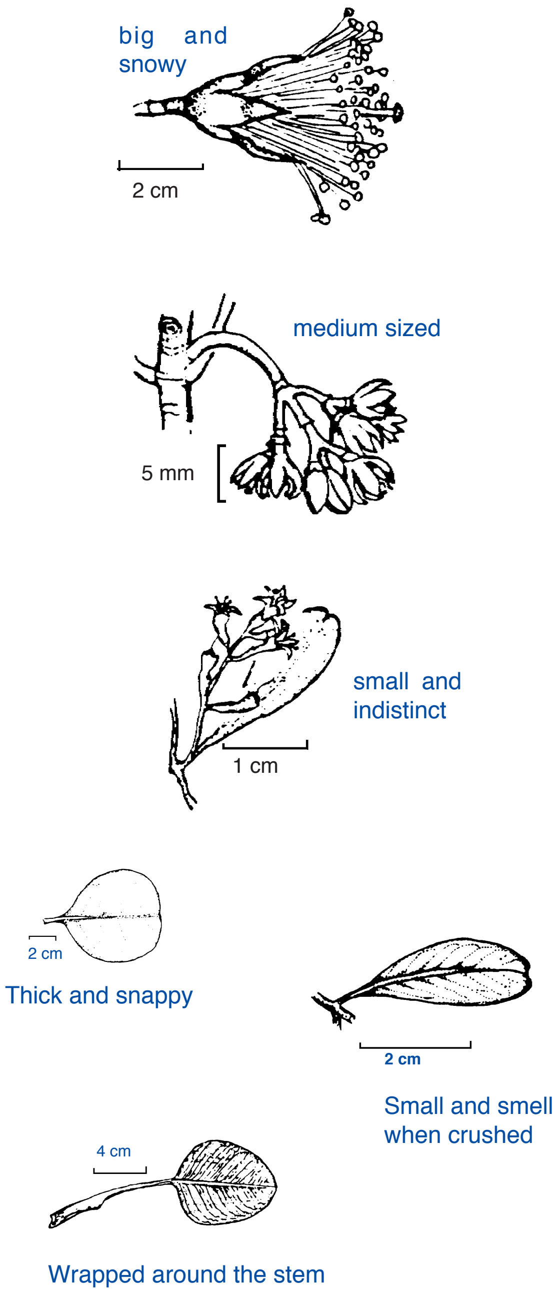


Figure 45.1 Mangrove flowers and leaves (After Michie 1991)
Wet Paper

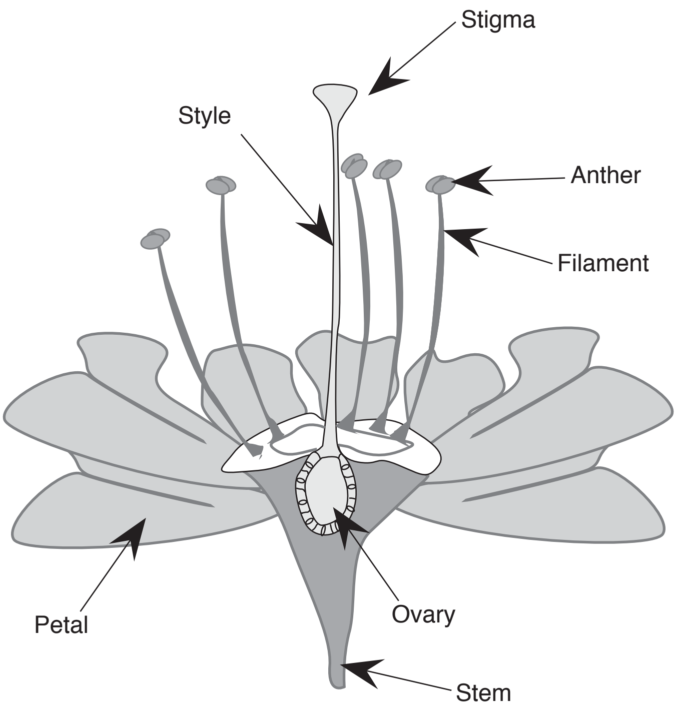


Figure 45.2 Generalised flower parts
Wet Paper

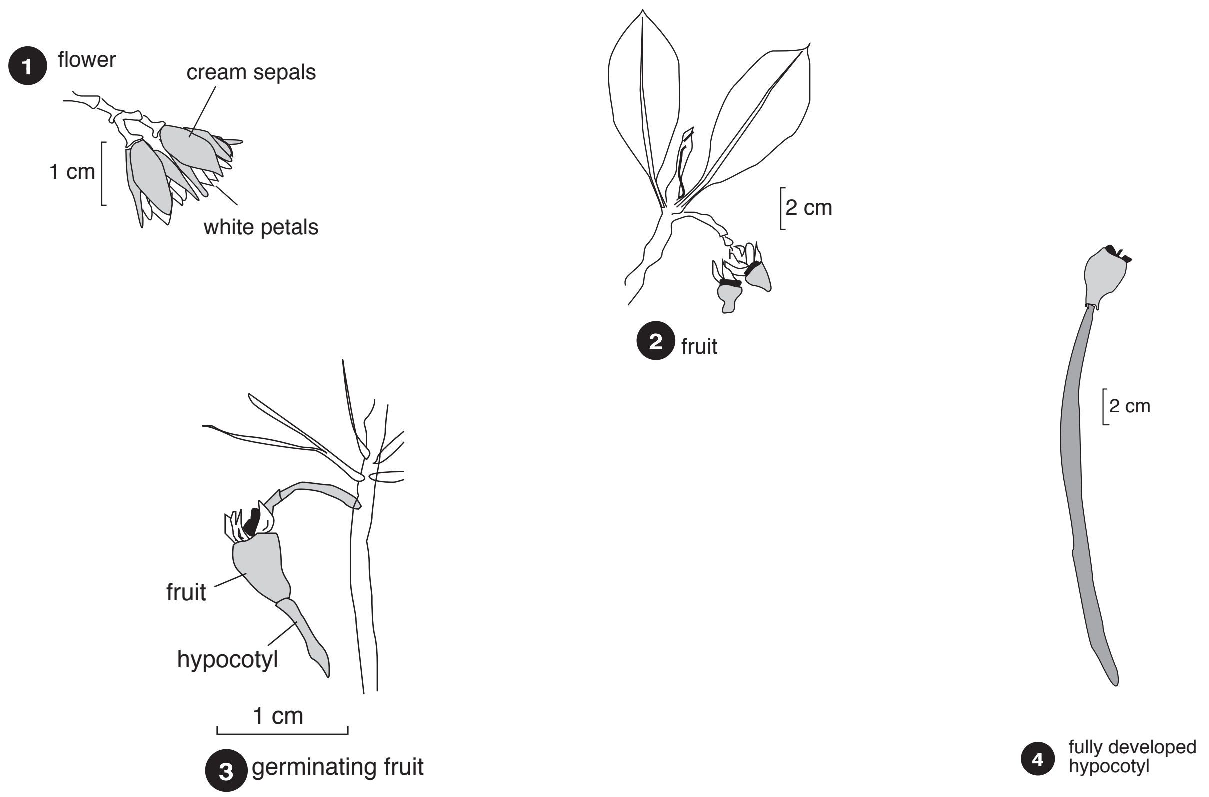


Figure 45.3 Mangrove reproductive stages (Illustrations Michie 1991)
Wet Paper

Exercise 46 How to build and use a plankton net

Method

Study the information in Figures 46.1, 46.2 and 46.3 before building your net.

1. Decide on the size of plankton you wish to catch and then order the net and mesh size.

   Nets come in a variety of screen sizes and if your area has very small plankton you should consider mesh size of 200 µ metres. Larger plankton can be caught with a mesh size of 300 µ metres.

2. Stainless steel will last a life time.
3. A marker buoy should be tied to the rope, so that if the net is lost, you can recover it quickly.
4. Use bowlines for all knots for safety and ease of untying.
5. Make a pattern before you cut the net. A sailmaker can sew it up and make the rings as shown in Figure 46.3.

Collecting plankton

1. Cut a PET bottle in half as a container to put your plankton in just after you catch it.
2. Store the net in a nally fishing crate so that it will be protected from tearing while transporting.
3. Use bowlines to secure both ends of the rope before towing and make sure safety buoy is spliced into the rope.
4. Tow at a slow speed. One knot to start with and then ask the skipper to increase speed until the net is just below the water's surface.
   - Don't throw the net in the water. Lower the net so that you can see it — you are not after benthos and sand.
   - Don't allow the net to become tangled in the prop.
5. Tow for about five minutes, then ask the skipper to stop, while you pull the net in.
   a. Pull the net straight up out of the water so that all the plankton doesn't tip out.
   b. Ask a friend to unscrew the bottle from the net.
   c. Pour the plankton into your half PET bottle and then into a test tube for analysis with a hand lens, or onto a petri dish for microscopic analysis.

Cleaning and caring for your net

a. Hose the net with fresh water to remove algae, sand and other debris.

b. Hang the net out to dry and then store away in dark dry place.

Building your own net

The stainless steel ring assembly

Steel rings can be assembled from a local steel manufacturer. Weld three pieces of chain to the ring and secure a swivel at the other end so that the net is free to rotate as it is dragged through the water. About 10 metres of silver rope can then be spliced to the swivel ring.

The net itself

Plankton net is made from a special type of material called bolting silk. One Australian supplier is:
Swiss Screens, 4/14 Randall St, Slacks Creek, Qld, 4127. Telephone (07) 209 5111. This manufacturer called the product Grid Gause, and to collect a general range of zooplankton, you would need about 1200 mm of 308 µ metres, nylon net nytal grid 56 BCYN. Swiss Screens also make up nets of your choice for plankton in your local area. Offcuts can also be used for making sand sieves (see activity 38).
Once the net is made a sailmaker can sew a hem and add the rings through which venetian blind cord can be drawn to secure the net to the ring.
The diameter of the net shown in Figure 46.3 is 360 mm tapering to 45 mm at the other end and 11 stainless eyes were sewn by the sailmaker.

Making the bottle

A plumber can make up a 40 mm waste pipe which could serve as the bottle. Two connections allow the bottle to be unscrewed after a sample is collected in the net. The male and female parts come from a sink fitting. The male part can be glued to the narrow end of the net with a stainless screw clamp (like the one you find connecting a radiator hose to a radiator in a car). The female part can be screwed into the male at one end. The other is glued to about 360 mm of 40 mm waste pipe. A cap is then glued to the end. To help the bottle move well through the water, 12 sawcuts as shown in Figure 46.3 were made from a builders drop saw half way through the pipe. Over this was glued (with 5 minute Araldite), some net offcuts.

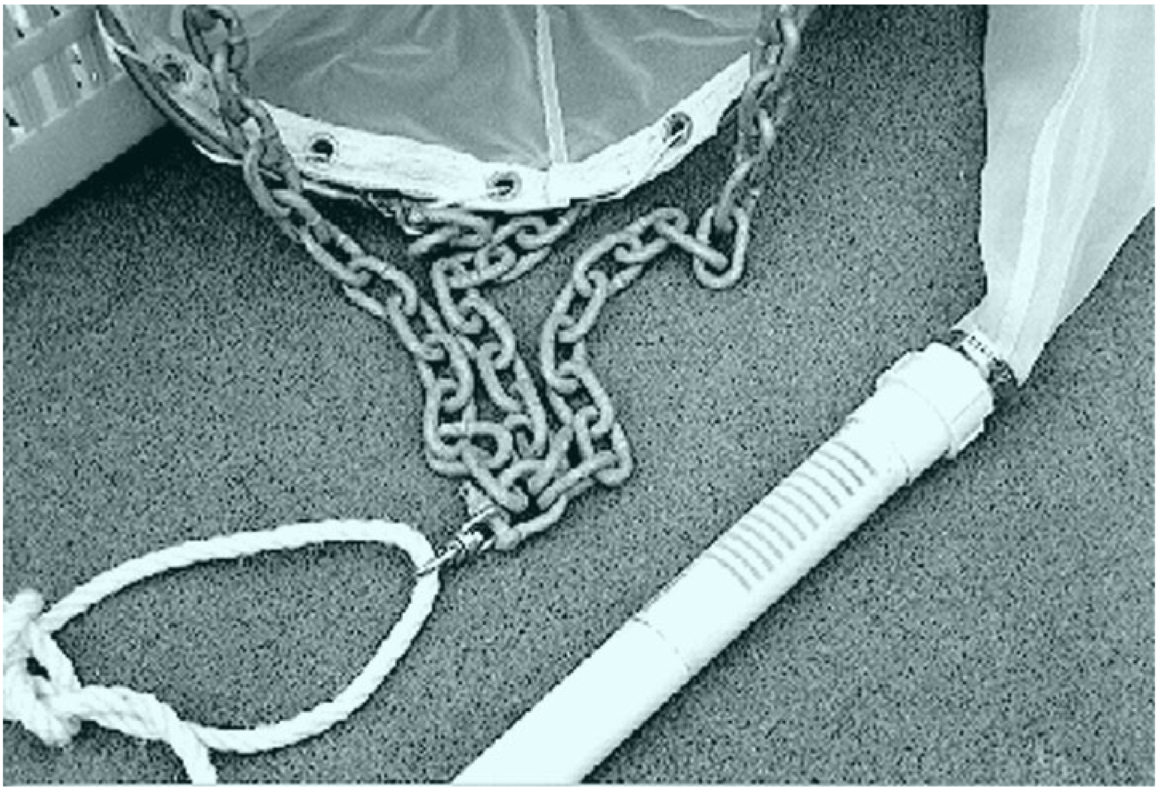
Alternate net

Figure 46.2 shows an alternate less expensive net, that Geoff Jensen from Innisfail SHS has built. If you would like details you can write to Wet Paper for a project sheet.

Figure 46.1 Net building instructions

Wet Paper

Figure 46.2 An inexpensive plankton net (Construction by Geoff Jensen Innisfail SHS)



Wet Paper

Figure 46.3 A more expensive home made plankton net: close-up of key elements (Wet Paper design)

Exercise 47
Sampling methods

Make a transect square

1. Construct or collect a transect square like the one shown in Figure 47.1.
2. Collect three buckets of coloured discs and sprinkle them over a 30 metre line.
3. Now place your transect square at the zero point called the datum point and select three colours to sample.
4. Randomly select a square by tossing a coin over your shoulder so that it lands in the square.
5. Now count each of the colours selected and multiply by the number of squares in the transect square.
6. Record the values for each colour.
7. Use the tape or metre rule to measure out five metres and repeat.
8. When you have finished, assemble your data and plot your graph in Figure 47.3.
9. Answer the following questions
   a. How did the numbers of the three discs change?
   b. What problems did you experience using this sampling method?
   c. Did the temperature change over the sample sites?
   d. What other types of data would be useful to collect in a transect?

Materials and equipment (per group)

- transect square as shown in Figure 47.1
- thermometer and coloured discs
- measuring tape or metre rule

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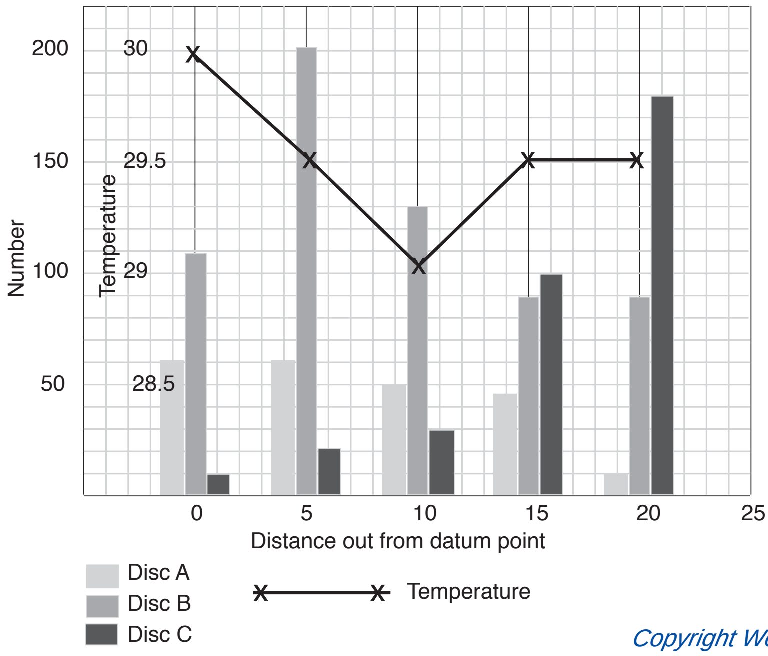
Figure 47.1 Homemade sampling transect square

Figure 47.2 Sample graph
Wet Paper



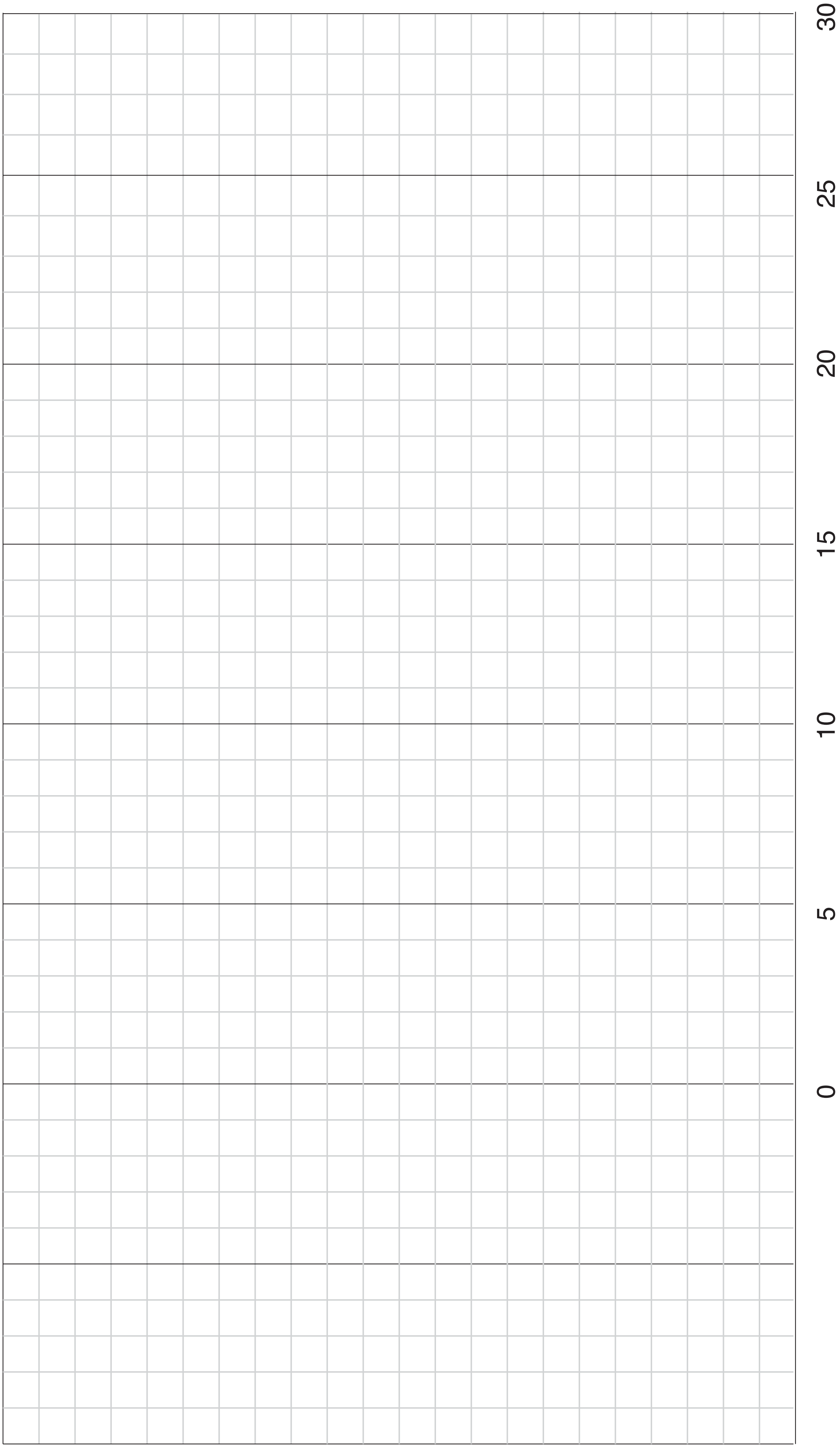


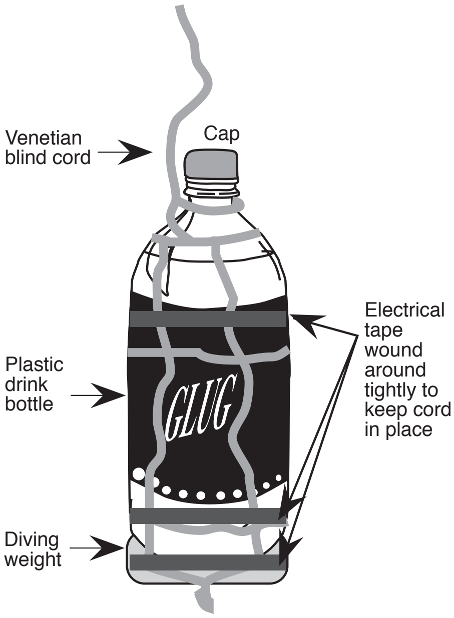
Figure 47.3 Graph for practice transect
Wet Paper

Water collection bottle

See Figure 47.4

1. Take an empty plastic 1.25 litre PET bottle and place a weight underneath. A brick as shown in Figure 47.5 or a diving weight will do.
2. Take some venetian blind cord and tie it to the weight and pass two ends up and around the neck of the bottle.
3. Now tape the weight to the bottom and the cord to the sides of the bottle as shown.
4. Wind on about 10 metres of cord to a piece of wooden dowel as shown and tie the other end to the bottle's neck.
5. To use the bottle, make sure you don't throw it more than 10 metres. The idea is to throw the bottle out from the shore or lower it from a boat with the top off.

   Quickly retrieve the bottle and screw on the cap so you can take it to your portable lab.



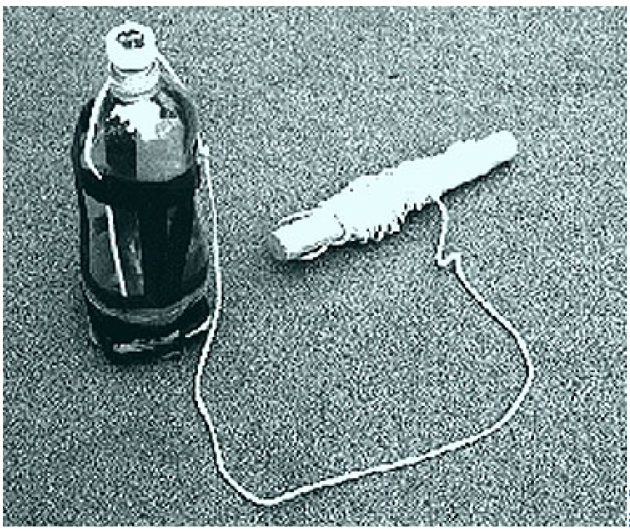


Figure 47.4 Homemade water sampling bottle

Secchi disc

Figures 47.5

1. Take a ice-cream container and paint with permanent black felt pen.
2. Take a brick or weight and secure to the bottom. For more lasting secchi discs, you can use iron or aluminium.
3. Mark out 15 metres of venetian blind cord in half metre lengths and tie one end to a dowel as shown and the other to the secchi disc.
4. Lower into the water as shown, counting each half metre, and watch for when the black squares disappear.

   Raise up and down until you and your partner agree the black has disappeared. Note the depth.

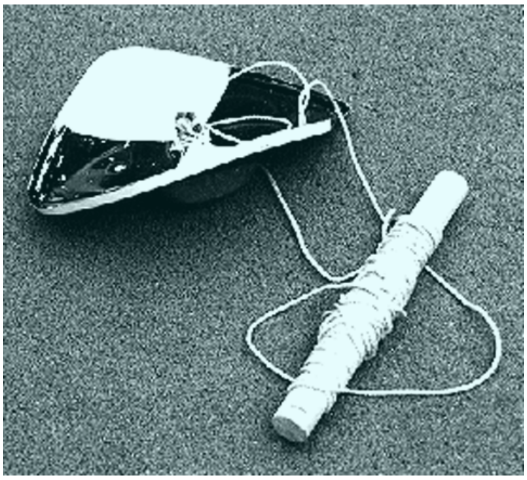


Figure 47.5 Home made secchi disc

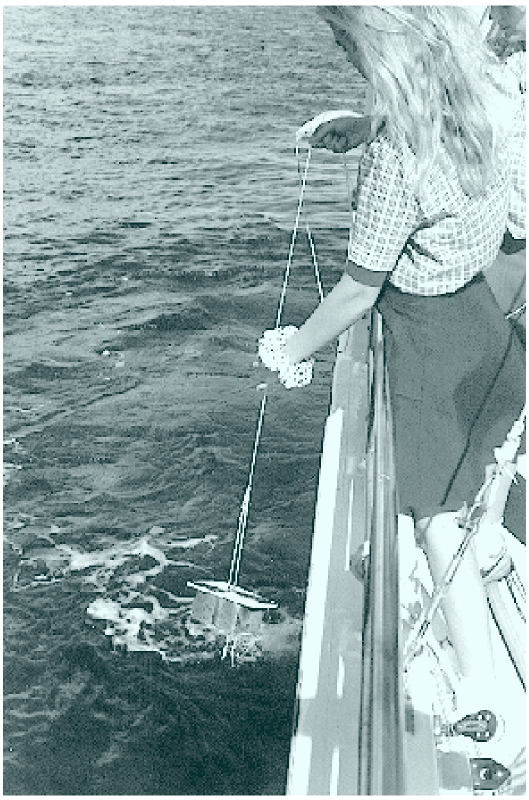


Figure 47.5 Using a secchi disc (Acknowledgement to Jan Thornton and Trevor Long at Sea World for help in taking this photo)

Turbidity tube

See Figure 47.6

1. Collect your sample of water with your water sampler bottle.
2. Shake the bottle vigorously and pour into the tube until the x at the bottom disappears. Follow the instructions that came with the tube.
3. Turbidity tubes are available from WaterWatch co-ordinators and are inexpensive items. They are not worth making for the price (See Exercise 128).

   Turbidity tubes are available from your State WaterWatch Co-ordinator.

Field thermometer

See Figure 47.7

1. You can use a simple field thermometer with a protective plastic case as shown.
2. The plastic comes from a home drip system irrigation tube and is supported by a large amount of electrical tape.
3. To make this cut a piece of drip irrigation system pipe just a bit longer than the thermometer.

   Thread a piece of fishing line or wiper snipper cord through the top of the thermometer so it passes about 20 cm down each side.

   Now insert the thermometer in into the sleeve and tape the fishing line the sides.

   Cut out the areas of the thermometer you don't want. E.g. In Queensland you would not need the 0-10^{o}C range but in Victoria and Tasmania you would.

   Use electrical tape to strengthen and store in a piece of drain pipe with a cap as shown in Figure 47.7.

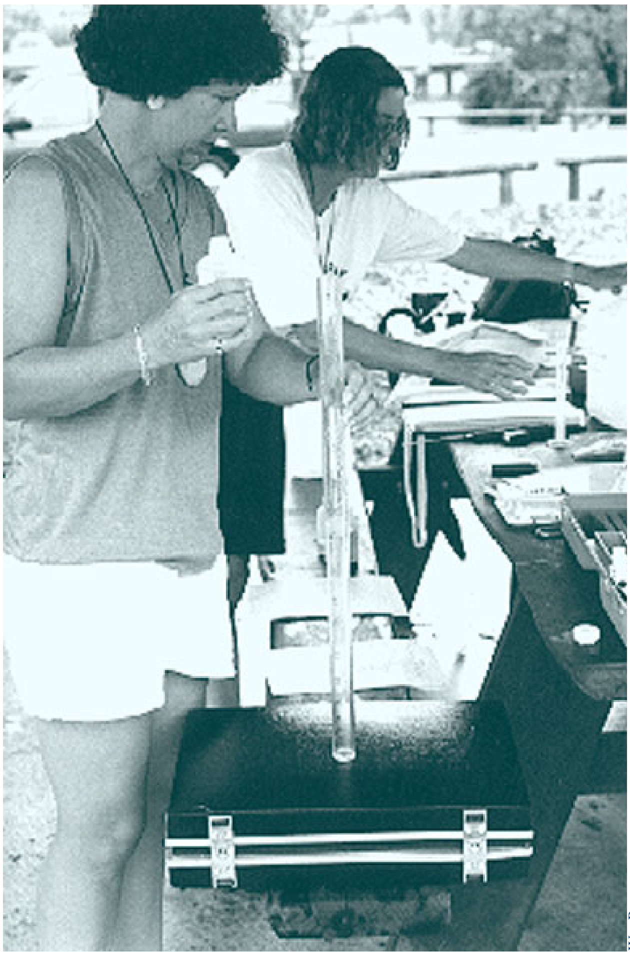


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Figure 47.6 Turbidity tube available from your WaterWatch co-ordinator

Wet Paper

Figure 47.7 Home made field thermometer. A number can be stored in some sink drain pipe with a cap at each end.

Exercise 48
Osmosis

Based on an original exercise by Tim Ryan, Maryborough State High School

Method

1. Open the cellulose tubing by wetting it and then rubbing it between your fingers. Cut off a 20 cm section.
2. Tie a knot in one end of the tubing.
3. Use a filter funnel to fill the bag with a starch solution.
4. Tie off the end with a rubber band to make a sausage like "organism".
5. Record its length and circumference.
6. Place it into a large beaker of water.
7. Add some iodine solution to the water in the beaker.
8. Record the colour changes after 50 minutes.
9. Repeat steps 1 to 7 but use a sugar solution instead of a starch solution.
10. Allow the bag to sit in the beaker for 50 minutes.
11. Record the size change in the bag and add a piece of Testape to the water in the beaker and record its colour.

Questions

1. What is the chemical test for starch?
2. What colour did the bag turn in step 8?
3. Describe the change in size of the bags in both cases.
4. What substances can pass through a cellulose membrane?
5. What is a "differentially permeable membrane"?

Materials and equipment (per group)

- distilled water
- cellulose tubing (dialysis tubing)
- starch solution
- sugar solution
- iodine solution
- test tape
- scissors
- filter funnel
- 2 beakers

Research essay

Read the article in Figure 48.1 and write a 200 word essay on the amount of water in a marine fish as it swam up a creek into fresh water.

Osmosis

In order for water to enter cells, it has to pass through a cell membrane. The mechanism which regulates this is called osmosis.

The membrane through which the water moves is called a semipermeable membrane. It allows some substances through while inhibiting others, e.g. water can pass through easily but salt has a greater difficulty.

Substances tend to move from a region of high concentration to a region of low concentration. This movement of molecules is called diffusion.

The diffusion of water will depend on there being a difference in concentrations on either side of the semipermeable membrane as shown below. Applying the laws of diffusion, water will diffuse from an area of high concentration to an area of low concentration. Salts are actively excreted by the gills of salt water fish. These fish produce very little urine.

Freshwater fish do not drink water because the water in their blood has high concentrations of salts causing water to be taken up automatically in the gills by osmosis as shown below. This water has to be removed by the urinary system and excreted as part of the urine.

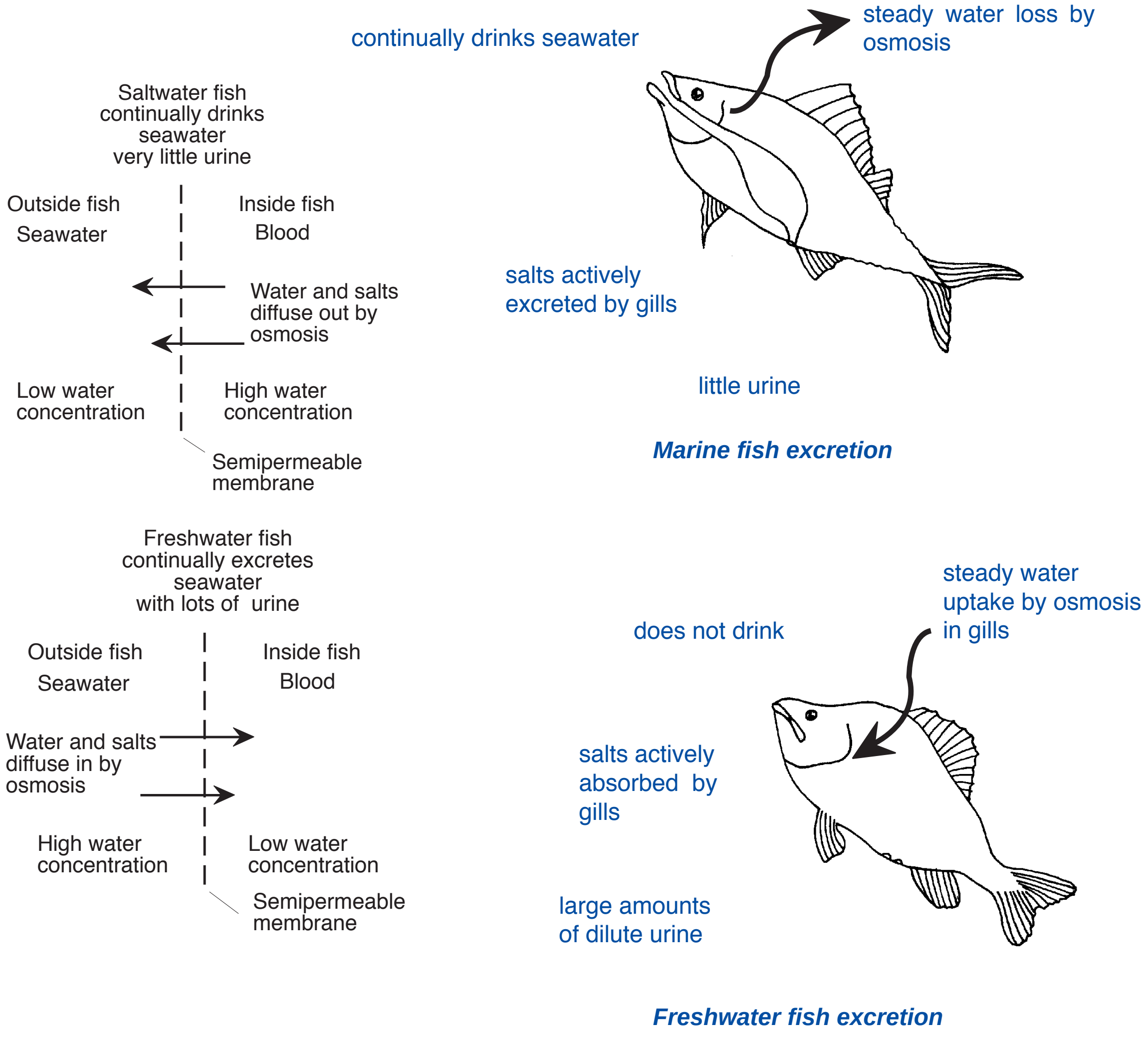


Figure 48.1 Comparison of physiological adaptations of fresh and marine fish

Wet Paper

Exercise 49
Environmental effects of freshwater

Based on an original exercise by Tim Ryan, Maryborough State High School

Questions

Read the notes and table on the requirements for a species for aquaculture in Figure 49.2, and answer the questions below.

1. Why do you think barramundi farms are not being established in southern states?
2. Which fish do you consider has the highest growth rate in the first 12 months?

   Explain why you think this may be so?
3. Which species produce the most eggs and which produce the least?

   Explain why you believe some species produce such large numbers of eggs.
4. Why do you think very few aquaculture ventures concentrate on the breeding of catfish and saratoga?
5. What effect does pollution have on freshwater animals? What are some of the pollutants that affect these animals and from where might they originate?
6. Why is there a need to set up freshwater aquaculture farms?
7. Why is it essential for the person setting up an aquaculture farm to know his animals and their needs?
8. What other factors may affect the growth rate and survival of these animals?
9. Why may future aquaculture ventures be sited near power stations?
10. Study Figure 49.1 and answer the following questions:
    a. What do you think is in the large conical flasks?
    b. Why do the flasks need light?
    c. What other requirements do the flasks require?
    d. In what stage of the aquaculture process, does this photograph represent?

Wet Paper

Figure 49.1 Aquaculturist

Notes on the requirements of a species for aquaculture

1. To have a high fecundity (produce a large number of viable young).
2. To have a high growth rate under pond conditions.
3. To be very hardy in the egg and larval stages so it can tolerate some environmental variations. The shorter the larval stage of the animal the better its chances of survival.
4. Not to be very susceptible to disease and to tolerate crowding, temperature changes, changes in pH and pollution.
5. To grow to market size in a short time.
6. To be easy to capture, handle and transport.
7. Can live in high densities.
8. Can live on a wide variety of food.
9. Is disease and parasite resistant.
10. Can be easily marketed.

Fish	Water temp. tolerance	pH acidity	Growth rate in 12 mths.	No. eggs produced	Eating quality	Pollution effect
Yellow Belly	4-37	neutral	22cm/yr	500000	excellent	fatal
Silver Perch	2-37	neutral	28cm/yr	500000	good	fatal
Saratoga	7-40	neutral	27cm/yr	50-100	poor	fatal
Murray Cod	2-30	neutral	30cm/yr	40000	excellent	fatal
Eeltailed Catfish	2-37	neutral	19cm/yr	20000	good but unmarketable	high tolerance
Marron	15-25	7-8	24cm/yr	700	excellent	fatal
Macrobrachium	15-40	7-8	22cm/yr	100000	excellent	fatal
Barramundi	15-40	neutral	45cm/yr	1-7million	excellent	fatal

Wet Paper

Figure 49.2 Requirements of a species for aquaculture

Exercise 50
Rocky shore habitats

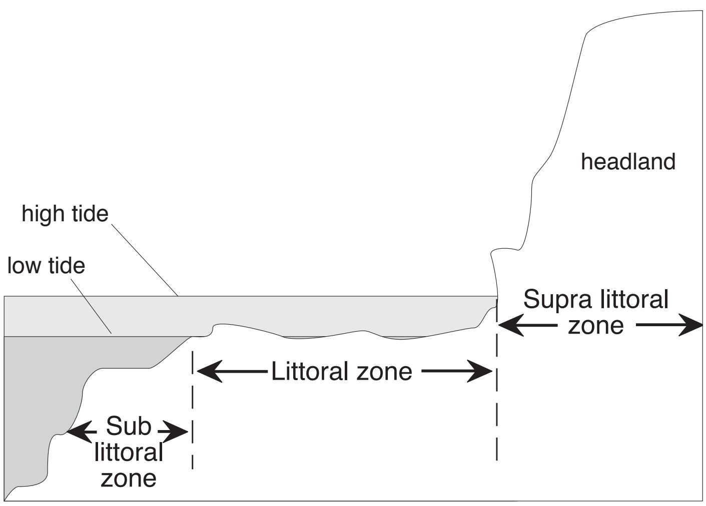
Questions

Use your textbook and the information in Figures 50.1 - 50.3 to answer the following questions.

1. Name the areas or zones on a rocky shore.
2. How many tides are shown in Figure 50.2?
3. Redraw Figure 50.1 to show the information shown in Figure 50.2.
4. Explain why there are two different heights for high tides in Figure 50.2.
5. How would the information presented in Figure 50.2 affect the information presented in Figure 50.1?
6. Study Figure 50.3 which shows the plot of the highest and lowest tides over a 29 day period.

   Redraw Figure 50.2 adding the sun, to explain the results shown.
7. Figure 50.1 shows a flat sea. How big do waves get in your local area and what effect do they have on the headland?
8. On a rocky shore, tides, waves, changes in temperature all effect the types of places or homes that animals and plants can live in.

   Make up a list of these habitats and say for each one how it will be affected by weather.



What the shore looks like

A rocky shore has a wide variety of shapes and sizes. It could be a long, flat wave cut platform with numerous pools and boulders or a cliff face with large boulders scattered along the bottom.

Whatever the case, the gaps and cracks provide places for animals to live and they must have certain features that help them survive.

Figure 50.1 Zones on a rocky shore

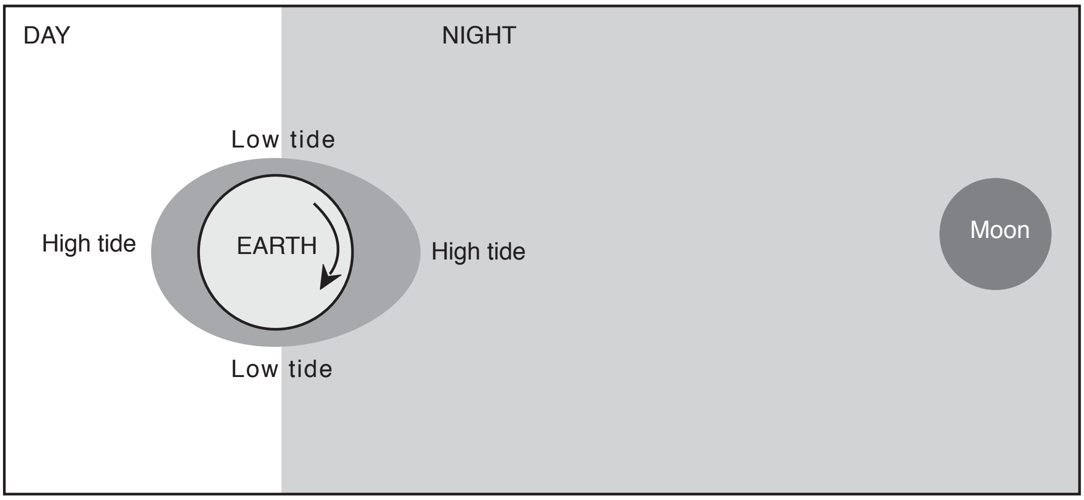


Figure 50.2 Daily tides
Wet Paper

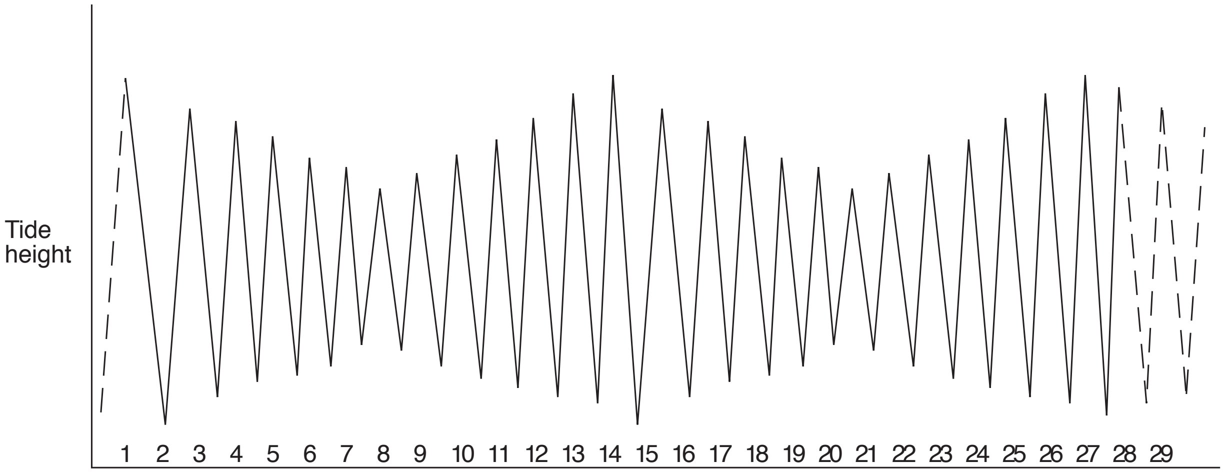


Figure 50.3 Monthly tides
Wet Paper

EXERCISE 51
ROCKY SHORE LIFE

QUESTIONS

1. Classify the animals shown as A, B and C in Figure 51.1 by using the family tree as shown on Page 421 of your textbook.

2. Locate the diagrams of the snail and anemone as shown in Figures 51.2 and Figure 51.3.

   a. To which group of animals does each belong?

   b. Draw lines to identify the following external features:
      - antennae
      - head
      - shell
      - foot
      - operculum
      - tentacles
      - mouth
      - basal disc
      - rock

   c. Identify which drawing is at low tide and which at high tide.

   d. What problems do these animals have at low tide?

   e. Name two adaptations each animal has to survive in the rocky shore environment.

3. Locate the diagrams of the crab as shown in Figure 51.4.

   a. What animal group does the crab belong?

   b. Complete the sentences in Figure 51.4.

   c. Name three places this animal lives.

   d. Name five adaptations the crab has made to live on the rocky shore.

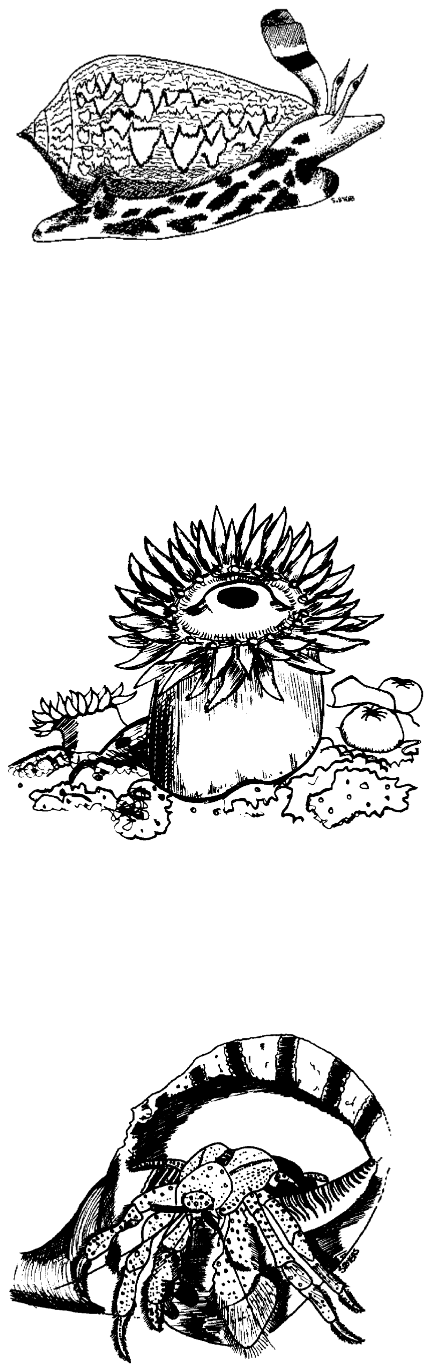


Figure 51.1 To which group do these animals belong? (Drawings by Steve Byers)

Figure 51.2 Snail question
Wet Paper

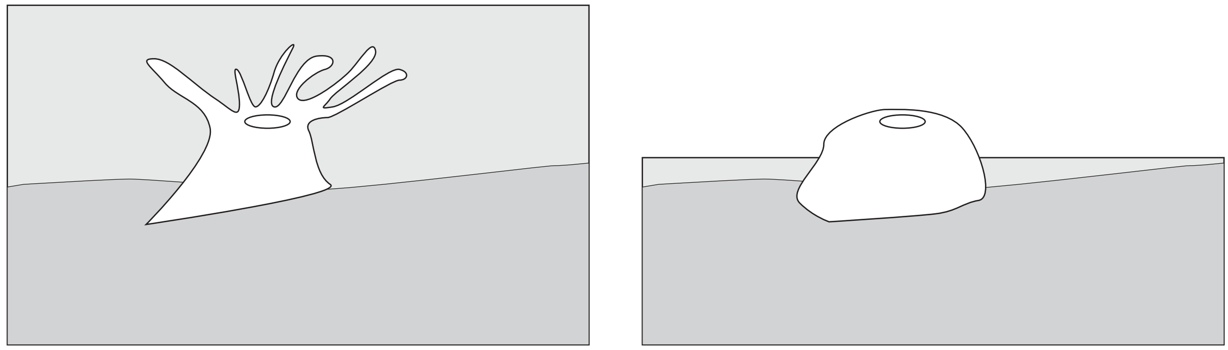


Figure 51.3 Anemone question
Wet Paper

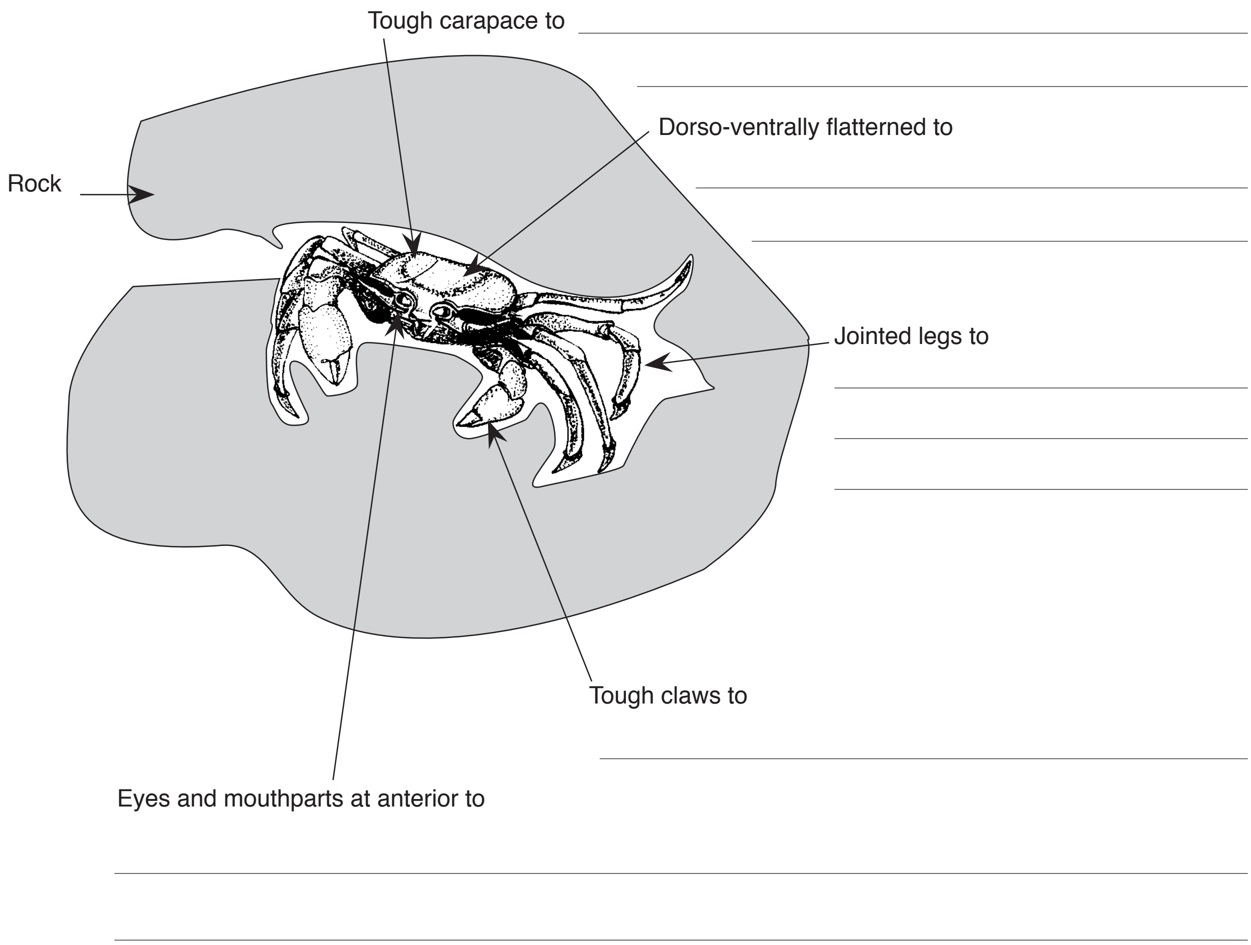


Figure 51.4 Crab in the rock worksheet. Students may make one copy of this page so that they can attach their answers before handing in for marking.
Wet Paper

Exercise 52 Looking at marine life

The following is a general introduction for the keeping of small invertebrate animals for Exercises 53 - 60.

Method

1. Set up a school marine aquarium similar to the one shown in Figure 52.1 and arrange with a local aquarium supplier or enthusiast to "lend or hire out" marine animals.

   You will need to check with the supplier or enthusiast about how to condition the water and what special requirements may be required.

   Take photographs of the areas where these marine animals come from and have them available for display during this activity.

   Have smaller aquariums available for in-class activities and impress on the students that these animals will die from stress if incorrectly handled.

2. Invite the local marine aquarist to visit the class to give lessons on handling live animals.
3. Avoid collecting specimens yourself if you are not a qualified aquarist or have no training in this area.
4. Immediately after you finish with the animals, place them back in the main tank and then contact the supplier to arrange for them to be collected.

Aquarium society

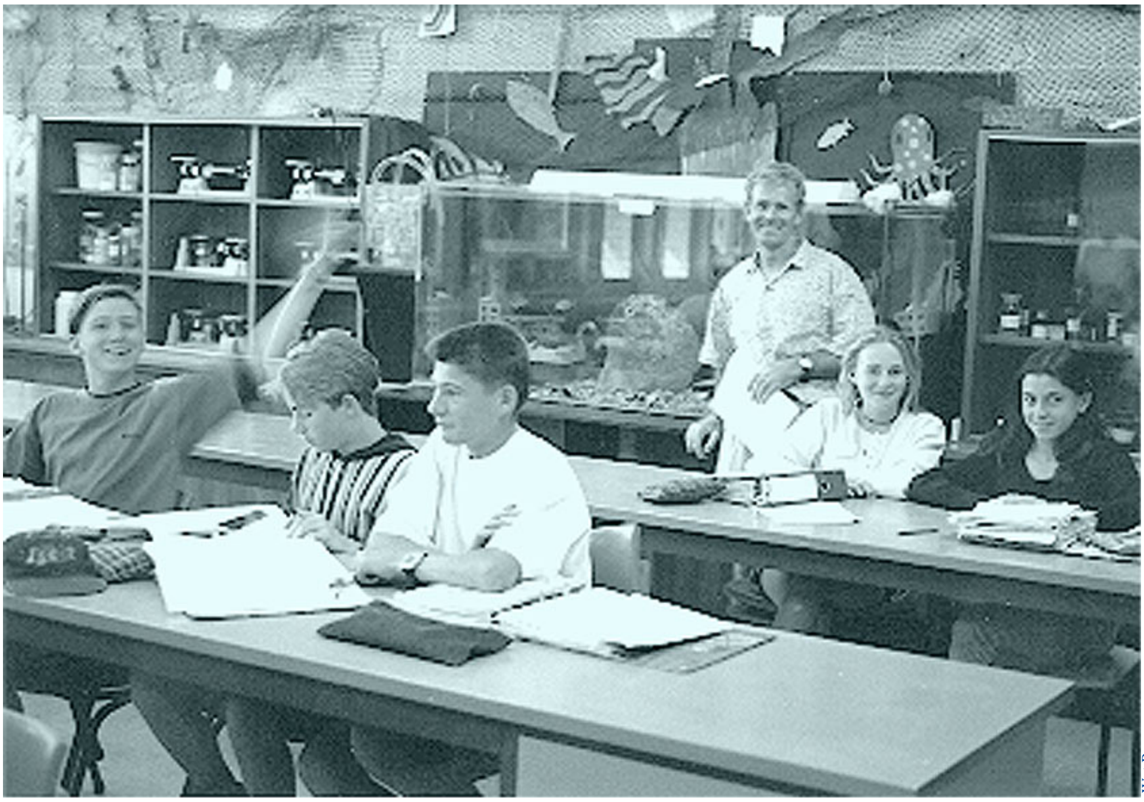
If you need assistance, why not contact a local aquarium society for advice? The object of observing animals and plants is to develop a love of them and to realise that we coexist on this planet and are not masters of it. If we are to preserve life on earth, we must learn to live in harmony, and understanding helps us to learn this.

Questions

1. What does the term conditioning the water refer to?
2. What special steps have to be taken when handling marine creatures?
3. Which invertebrate marine creatures are incompatible in any one tank and why?
4. Snails are often included in an aquarium. Why?
5. What type of aeration is necessary?

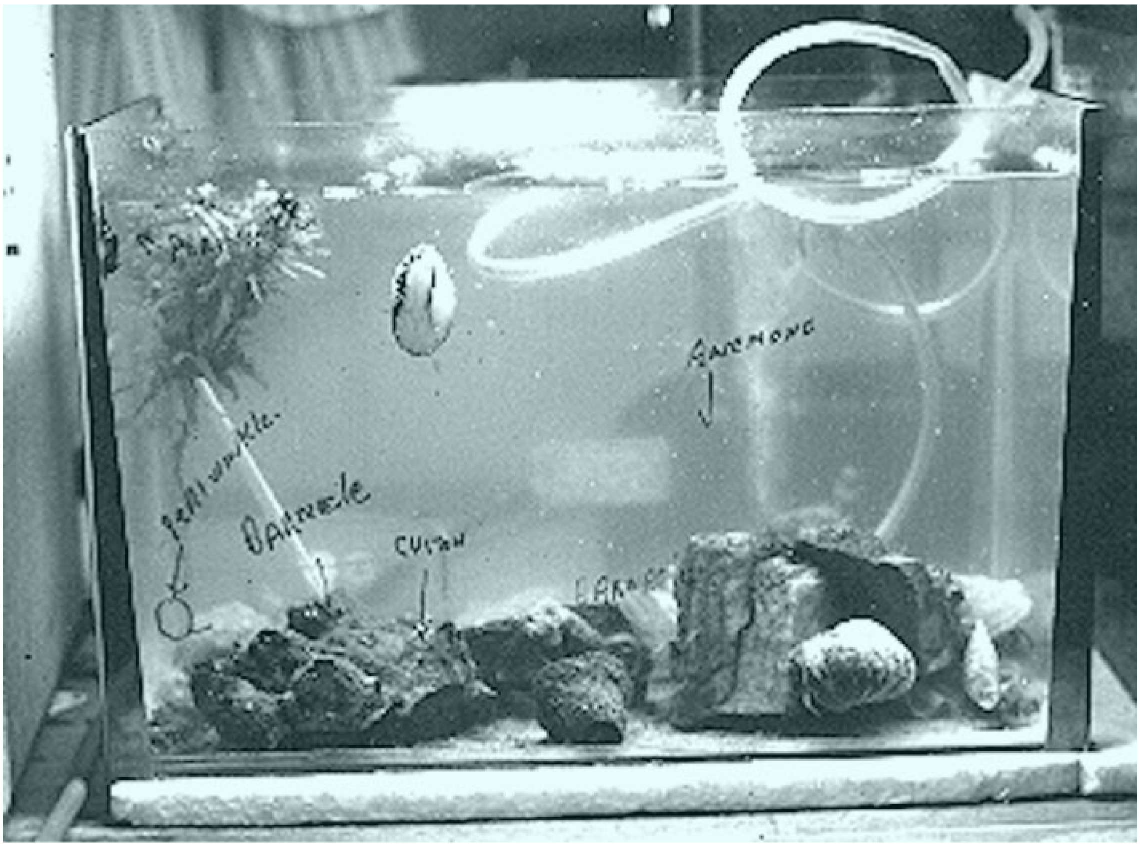
Materials and equipment (per class)

- large school aquarium
- smaller aquariums with fresh sea water
- aerator
- clean stones and washed coarse shell grit
- variety of hardy invertebrates such as barnacles, chitons or hermit crabs



Wet Paper

Figure 52.1 A large school aquarium in the back of your marine studies room adds atmosphere to a class



Wet Paper

Figure 52.2 A smaller aquarium can be used for double practical classes to study specific animals and plants which are then either returned to the aquarium shop or put back in a larger holding tank

Exercise 53
Barnacles

Read the conservation section on Looking at marine life in Exercise 52 before you do this activity.

Method

1. Create a small rocky shore in your aquarium by placing a series of washed rocks in one corner.
2. Arrange the aeration bubbles to come up through the rocks.
3. Carefully place the barnacle on these rocks and allow a few minutes for the animal to settle.
4. Carefully watch the top of the barnacle and identify the feeding cirri as outlined on Page 407 of your textbook.

   Complete Figure 53.1 to show what happens when a wave breaks.

Questions

1. Study Figure 53.2 and complete the table to identify the parts labelled A - F.
2. Use your textbook to make a description of how a barnacle feeds.
3. Make copies of the three stages of the life cycle of the barnacle as shown in Figure 53.3 and with some scissors arrange the stages in correct order, using Page 408 of your textbook as a guide.
4. Now write a paragraph on the life cycle of the barnacle and how it settles on a rock.
5. Barnacles are found in the sub-littoral zone. Name three adaptations that make the animal so well adapted to this area.
6. Many animals on the rocky shore have a conical shape. How does this help them survive?

Materials and Equipment (per group)

- small aquarium with fresh sea water
- aerator
- clean stones and washed course shell grit
- a barnacle

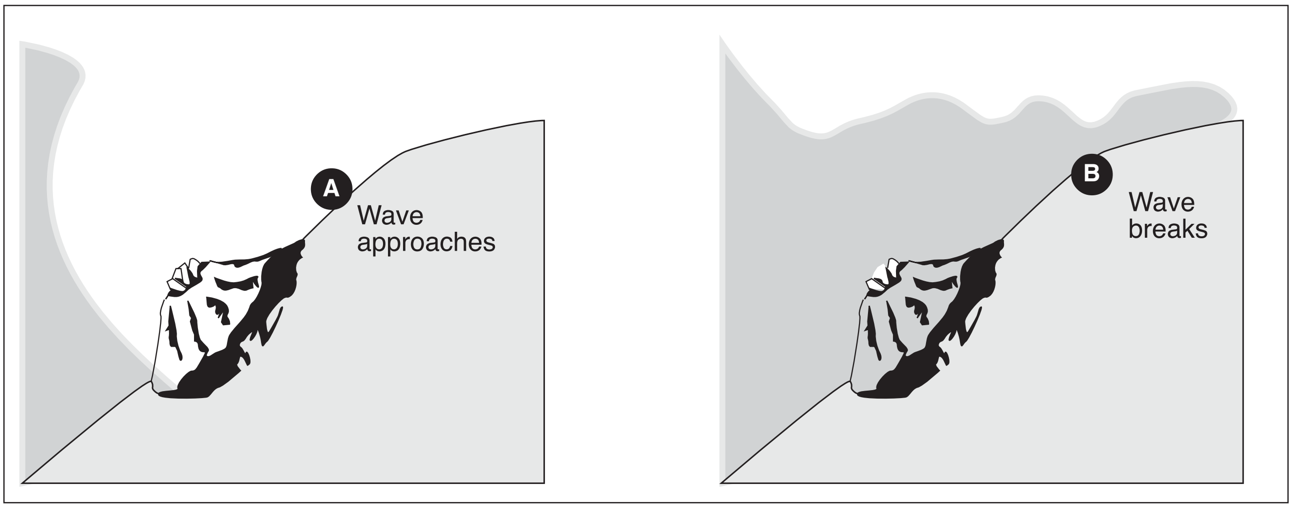
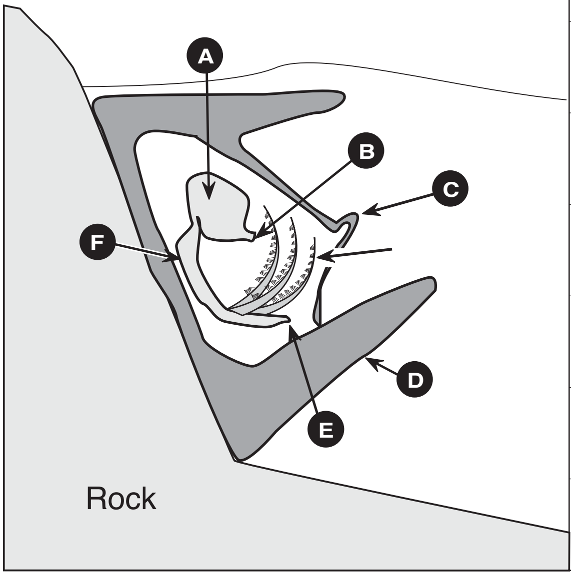


Figure 53.1 Barnacle feeding and non feeding situations
Wet Paper



Barnacle part	Name found in textbook
A	
B	
C	
D	
E	
F	

Figure 53.2 Barnacle anatomy
Wet Paper

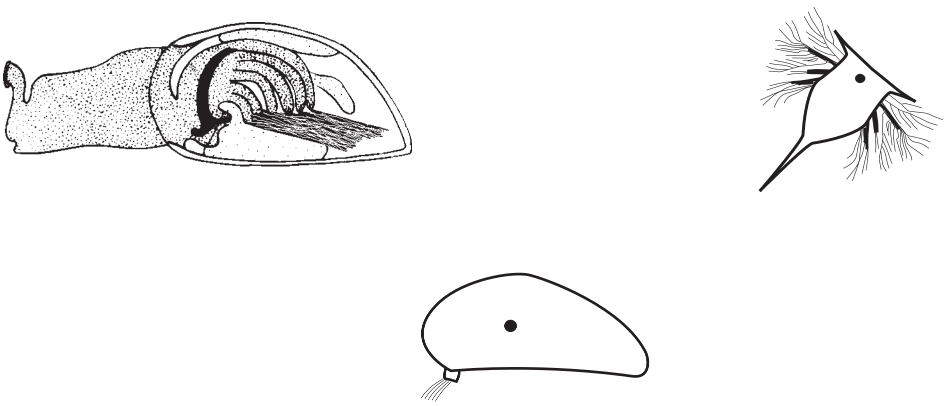


Figure 53. 3 Barnacle life cycle. Students may make one copy of this page so that they can attach their answers before handing in for marking.
Wet Paper

EXERCISE 54
GASTROPODS

METHOD

1. Carefully collect a gastropod and place it in your aquarium. Make a careful observation of how the gastropod moves and feeds and write down what you observe.
2. Can you see what the animal is trying to feed off?
3. Are you able to see the proboscis and mouth parts as shown in Figure 54.3B.

QUESTIONS

Use your textbook to answer the following questions.

1. To which group of animals does the chiton belong?
2. From your observation of the gastropod in the tank and by studying Figure 54.3, make a description of how this group of animals feeds.
3. What would happen if all the chitons and snails were removed from the rocky shores?
4. Draw lines to identify the following internal features of the generalised mollusc as shown in Figure 54.3A from page 468 of your textbook:

   shell, body organs, eye, tentacle, head, mouth, foot, anus and gills.
5. Identify the anterior and posterior parts of the chiton as shown in Figure 54.4:

   anterior, posterior, girdle, plates.
6. Chitons are very well adapted animals to survival on a rocky shore. Give two reasons for this statement.
7. What stage development is Figure 54.1 and where is it found?
8. What lives in the shell of Figure 54.2.
9. Name any other three gastropods.

MATERIALS AND EQUIPMENT (PER GROUP)

- small aquarium with fresh sea water
- aerator
- clean stones and washed course shell grit
- a marine snail or chiton

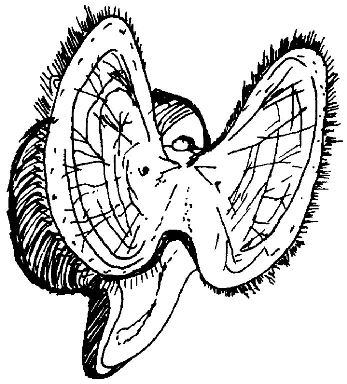


Figure 54.1 What is this? (Drawing by Meron Kilgour)

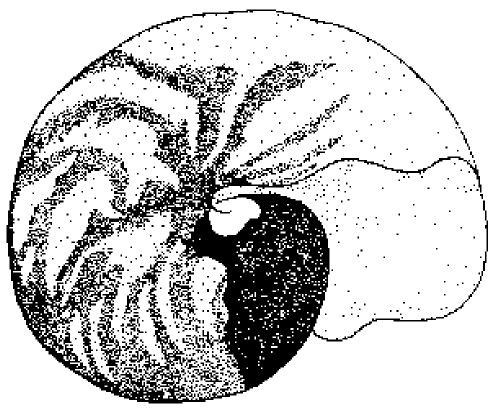


Figure 54.2 What lives inside this shell? (Drawing by Sue Oats)

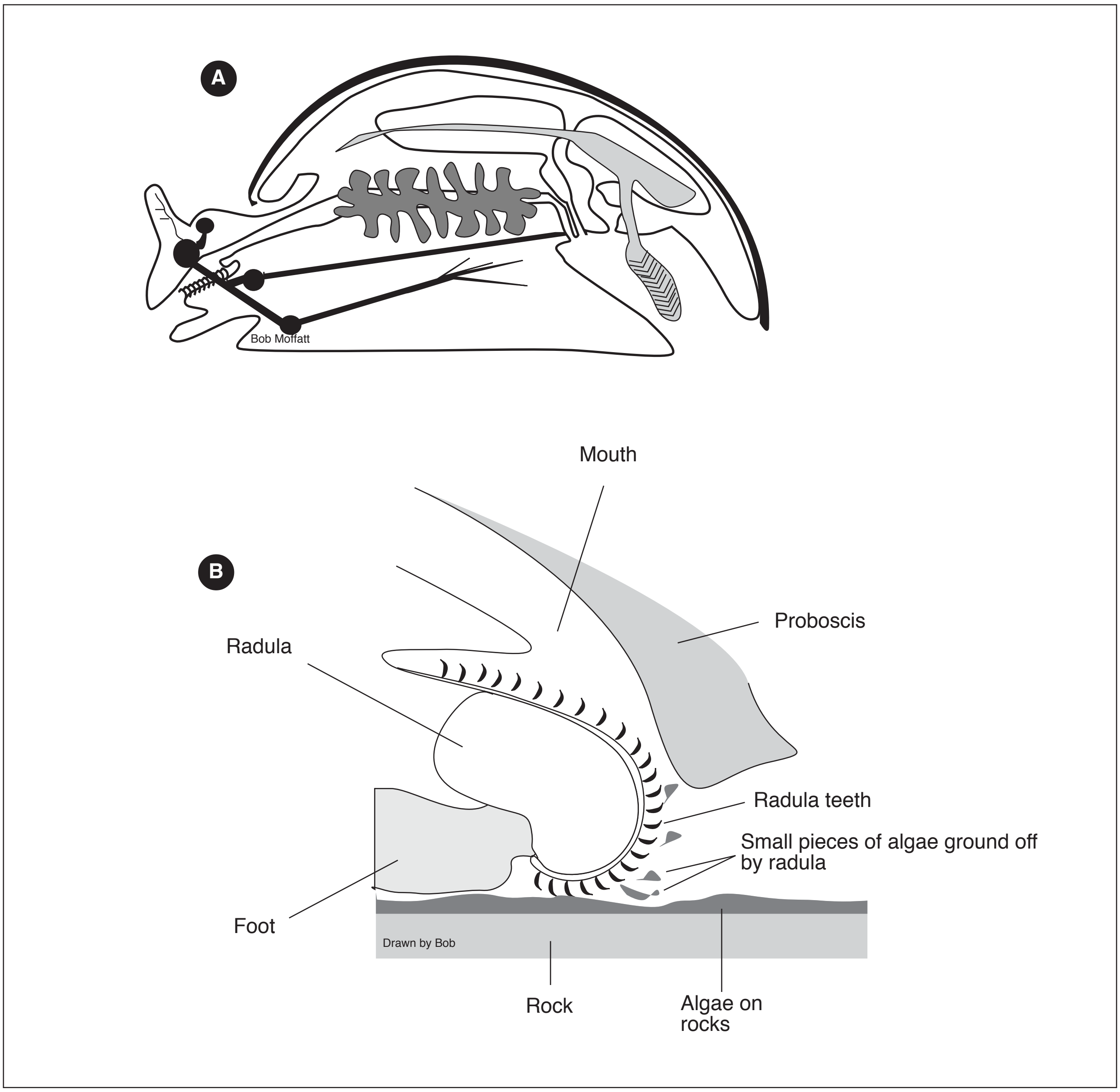


Figure 54.3 General gastropod cross section (After Lerman 1986)
Wet Paper

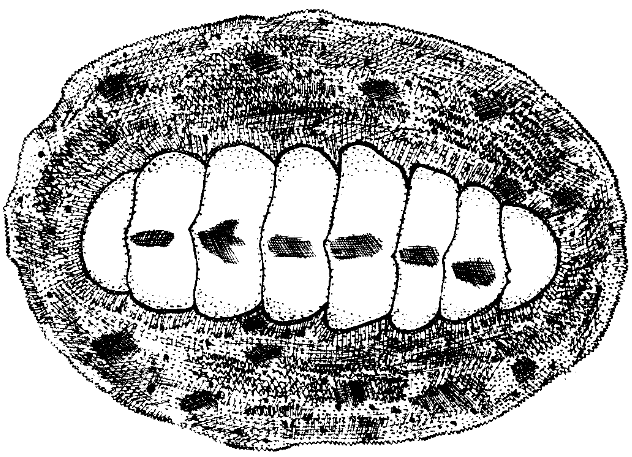


Figure 54.4 Chiton external features. (Drawn by Steven Byers)

Exercise 55
Algae

Read the conservation section on Looking at marine life in Exercise 52 before you do this activity.

Method

1. Collect a small amount of green algal slime (Spirogyra) and place it on a microscope slide.

   Add a drop of fresh water and carefully place a cover slip over the top.

2. Identify the parts of the algae as shown in Figure 55.1

3. Now add a drop of salt water and observe carefully what happens to the vacuoles.

   Write down an explanation for what you saw.

Questions

1. What specialized type of feeding apparatus would be required to remove the algae from the rock?

2. What would happen if all the algal grazers on a rocky shore were removed?

3. Nutrients such as phosphates and nitrates cause algal blooms. Why is this so?

4. Use your textbook to find out the special algae that live around the margins of the shells of the giant clam as shown in Figure 55.2.

   What role do these algae play and what type of adaptation and association exists between the algae and the clam?

5. In the space next to Figure 55.4, draw a diagram to show what type of mouth parts the fish may have. Use your textbook to check your answer.

   What type of fish is shown in this Figure and when does it feed?

Materials and equipment (per group)

- monocular microscope
- microscope slides and cover slips
- fresh water algal slime - spirogyra or equivalent
- eye dropper
- fresh and saltwater solution

Conservation hints

1. Set up a school pond to grow algae in advance so that you don't have to collect from a local stream.

   Take photographs of the stream where the algae grows and have them available in class.

2. A permit is required to collect in Marine and Protected Areas. Make sure you check before any collecting of specimens is done.

6. Use your textbook to add the following identification features to Figure 55.3
   - round, flat, thick epidermis resists desiccation and absorbs waves as they break
   - thick encrusted holdfasts
   - base cemented to rocks
   - tough "leathery "epidermis

7. Why does the algae in Figure 55.3 need a tough leathery coat and how does this help the plant survive?

8. Where do you think this algae lives? Give reasons for your answer.

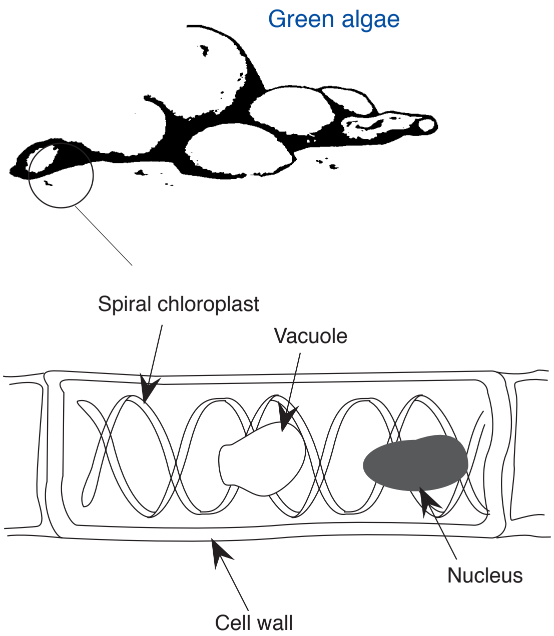


Figure 55.1 A fresh water algae x 300 approx.
Wet Paper

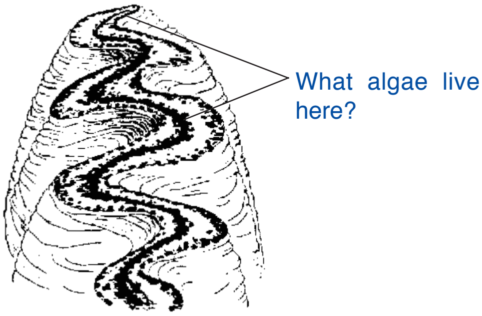


Figure 55.2 Algae and giant clam
Wet Paper

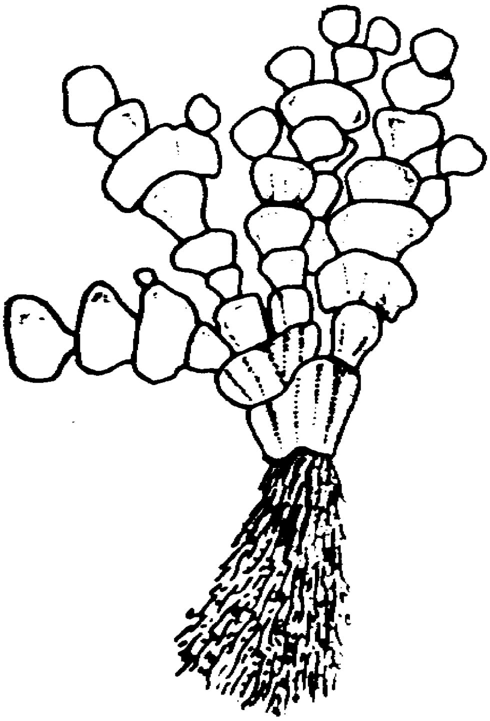


Figure 55.3 Algae that grows in sand and grit
Wet Paper

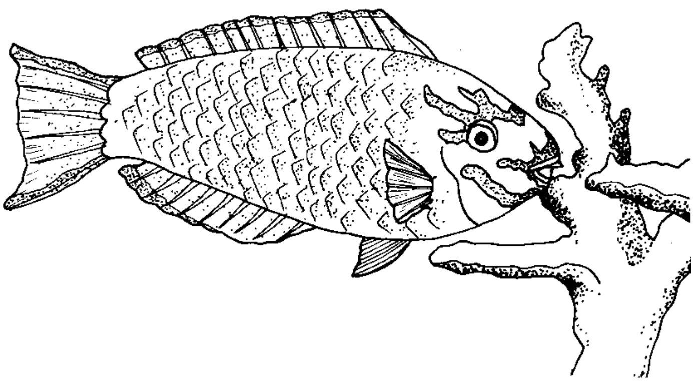


Figure 55.4 Algae on a coral clump. (Drawings by Steven Byers). Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 56
Corals

Questions

Use the brochure "The soft touch" and "The coral polyp", your textbook and Figures 56.1 to 56.3 to answer the following questions

1. Define soft corals.
2. What do they lack in their skeletons?
3. What role do small algae play that live inside the tissues of the coral ?
4. Write two sentences on the chemical defence mechanisms of soft corals.
5. What role do the thorn like spicules play in the protection of these corals?
6. How is the egg cowrie able to eat soft corals?
7. What scientific evidence has been obtained which explains why the egg cowrie doesn't die after eating soft corals.
8. Use your textbook to identify the corals shown in Figure 56.1.
9. Identify the parts of coral anatomy identified by A to H in Figure 56.3.
10. Describe a coral polyp in two sentences.
11. Use figure 56.2 to explain what happens to hard corals during the day and why?
12. What are corals closest relatives?
13. What are septa?
14. What are zooxanthellae and what do they do?
15. Describe how corals feed.
16. Make a coloured drawing of the coral colony on Page 3 of the brochure.

Materials and equipment (per group)

One copy of each of the pamphlets "A Coral Polyp" and "The Soft Touch" available from:

Great Barrier Reef Marine Park Authority
PO Box 1379 Townsville Q 4810
Fax: (077) 72 6093

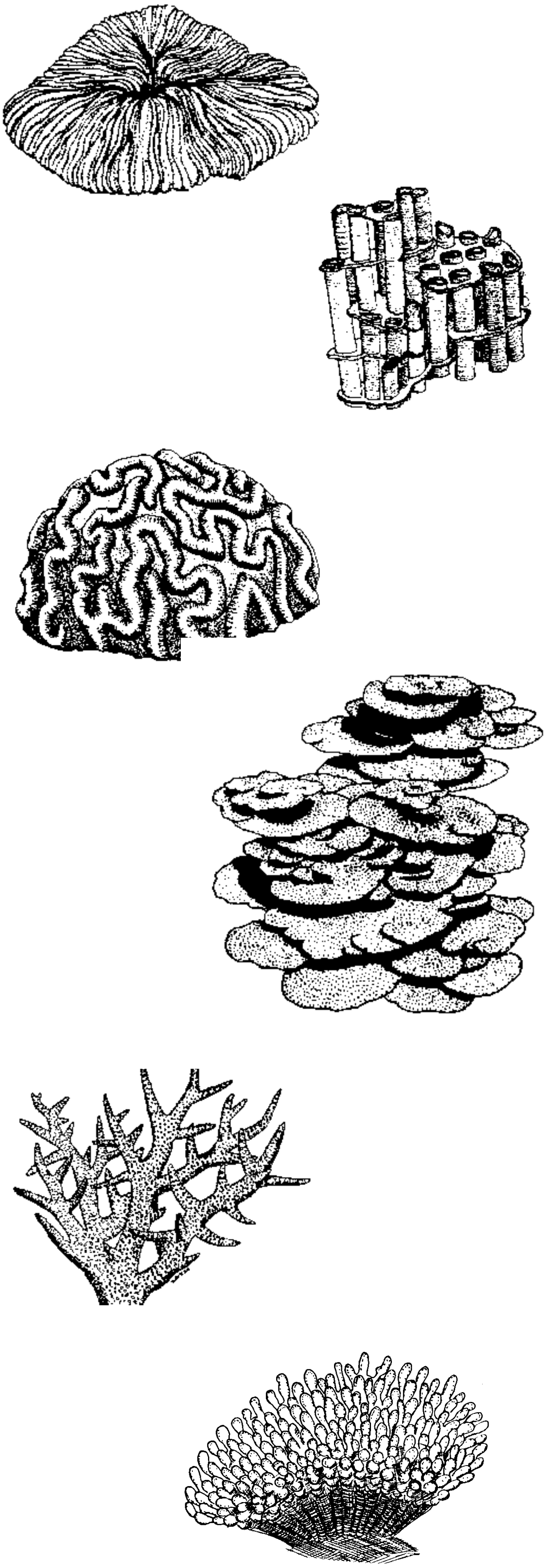


Figure 56.1 Various types of coral. (Acknowledgement to GBRMPA for illustrations C and D from Project Reef Ed, other drawn by Sue Oats)

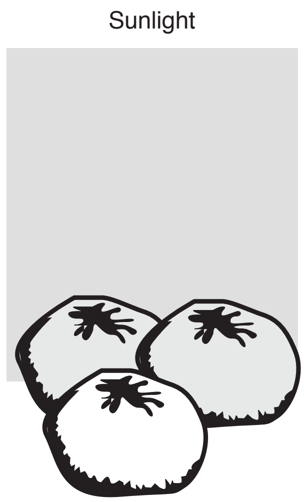


Figure 56.2 Corals by day
Wet Paper

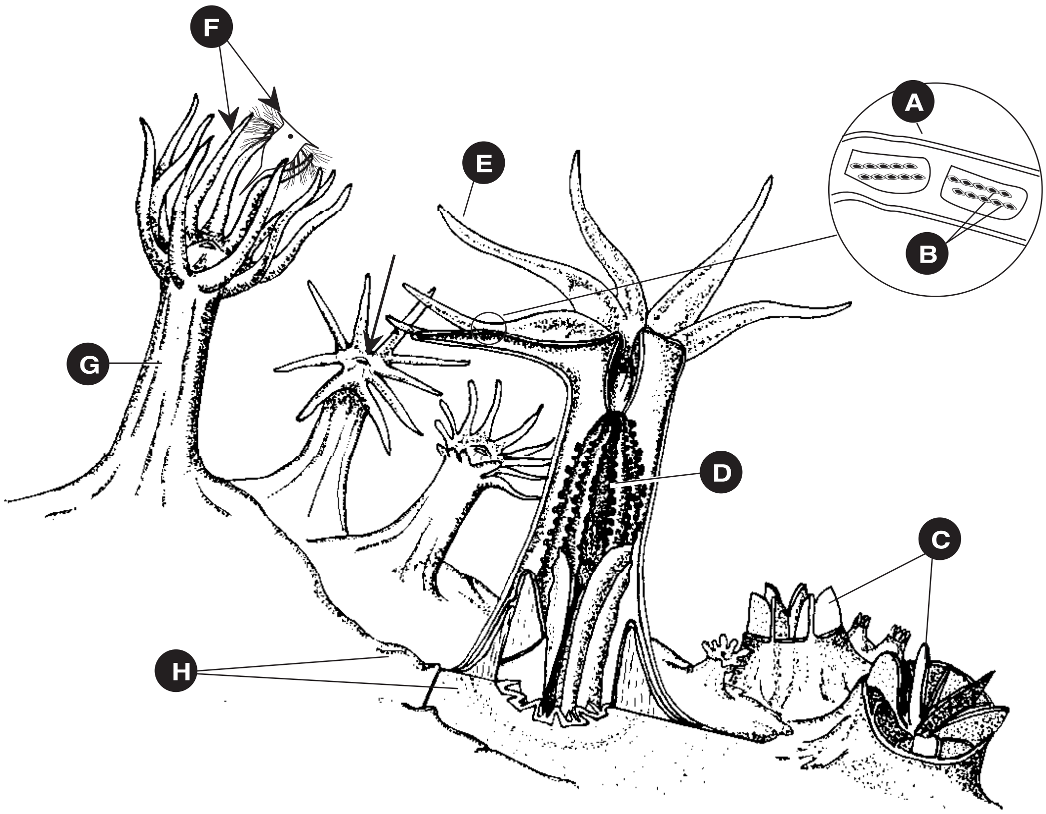


Figure 56.3 Corals feeding. Students may make one copy of this page so that they can attach their answers before handing in for marking.
Wet Paper

Exercise 57
Echinoderms

Read the conservation section on Looking at marine life in Exercise 52 before you do this activity.

Method

1. Arrange the stones along the bottom of your aquarium.
2. Carefully place an echinoderm in your aquarium and observe how it moves.

   Make a series of drawings to follow 57.3A in the space provided.
3. Now remove the starfish from the tank and place it upside down on a large petri dish.

   Place the petri dish under the stero microscope and observe the structures shown in Figure 57.2.

   Try to identify the maderporite, connecting canal and tubed feet.

   Make a description of how the tubed feet operate.

Questions

1. Use your textbook to identify the various echinoderms as shown in Figure 57.1 B - G.
2. What stage is Figure 57.1 A and where is it found?
3. Make a description of how tubed feet assist in starfish locomotion in the space provided in Figure 57.2.
3. Figure 57.1 E is a famous starfish. Do you know why? If so outline what significance it has played on the Great Barrier Reef.
4. Surfers often complain about sea eggs. Do these bear any resemblance to Figure 57.1 F and why are they so painful?

Materials and equipment (per group)

- an echinoderm - (suggestions: starfish or sea urchin)
- small aquarium with fresh sea water
- large petri dish
- stero-microscope

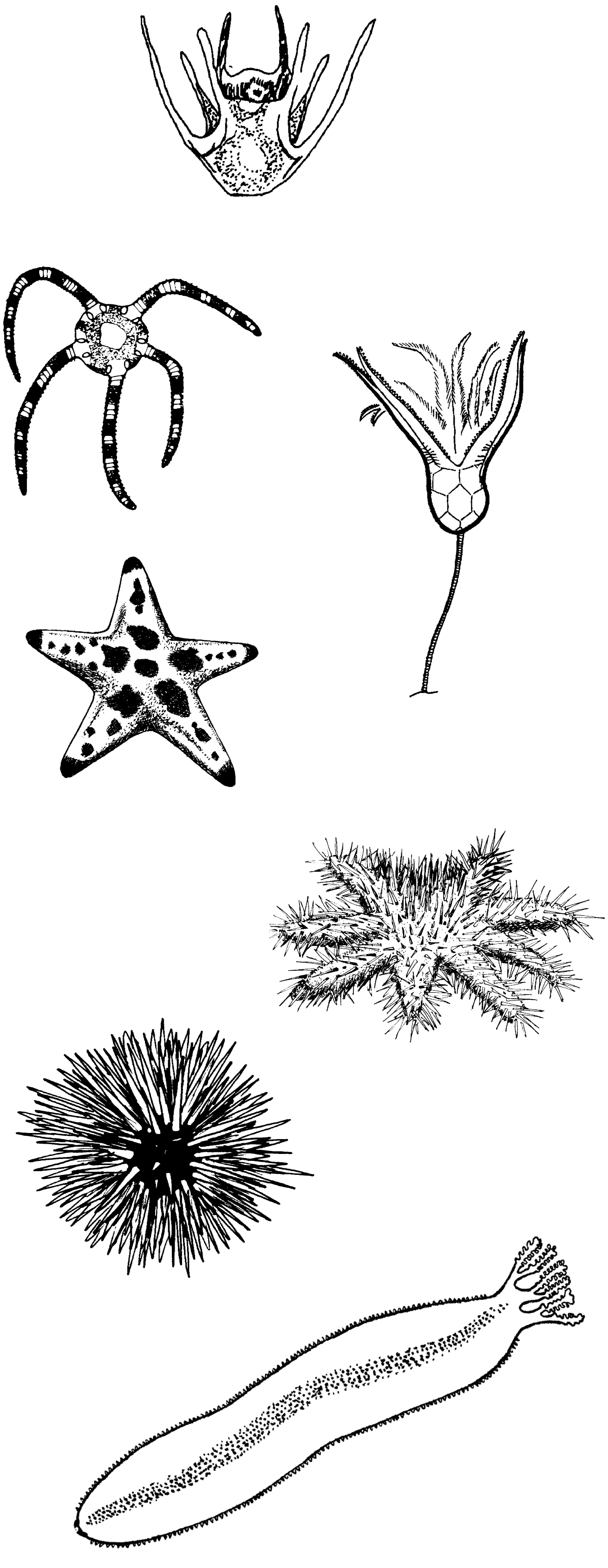
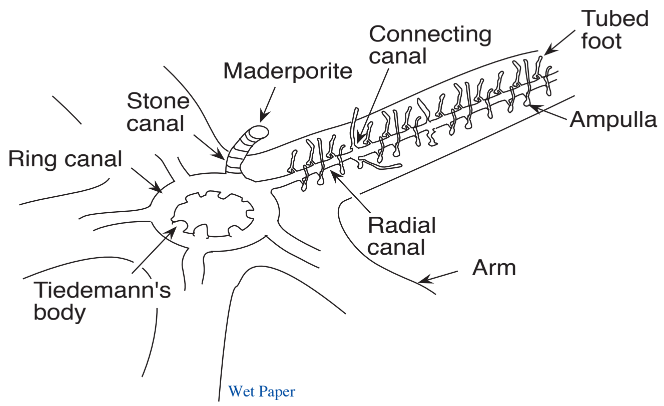


Figure 57.1 Various echinoderms
Wet Paper



Description of how tubed feet aid locomotion

Figure 57.2 Echinoderm ventral view (Lerman 1986) and your description of how tubed feet aid locomotion

Figure 57.3 Echinoderm movements. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Wet Paper

Exercise 58
Cephalopods

Questions

1. Use your textbook Page 424 to locate a drawing of the squid in Figure 58.1 and mark in the following external features.
   - mouth
   - arms
   - tentacle
   - mantle
   - shell
2. Now identify each of these in the squid from the specimen supplied.
3. Use your textbook Page 472 to mark the following internal anatomical parts on Figure 58.2:
   - mantle
   - shell
   - gill
   - oesophagus
   - anus
   - funnel
   - mouth
4. Use your textbook Page 424 to identify the parts of the squid life cycle as shown in Figure 58.3. Mark these on the drawing.

   Make a descriptive summary from your textbook to illustrate how a squid copulates.
5. Do you think there is any relationship with the ways squid mate and the commercial methods used to catch them? Give reasons for your answer.
6. Do you like calamari and if so how do you like it cooked?
7. Make a drawing of a squid jig and describe some ways used to preserve them.

Materials and equipment (per group)

- a packet of squid from the bait shop
- dissection tray
- dissection equipment

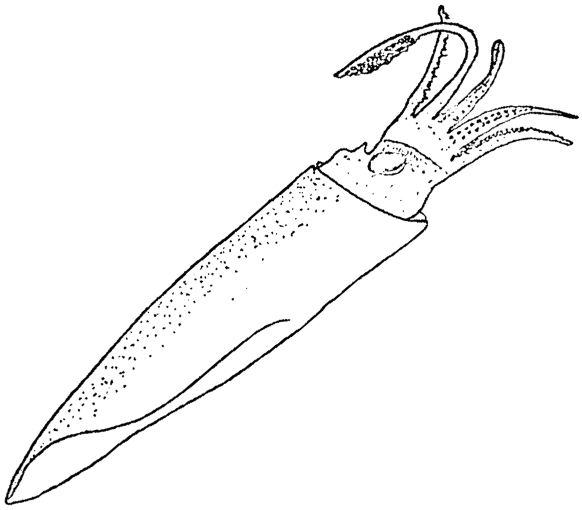


Figure 58.1 Squid external features
Wet Paper

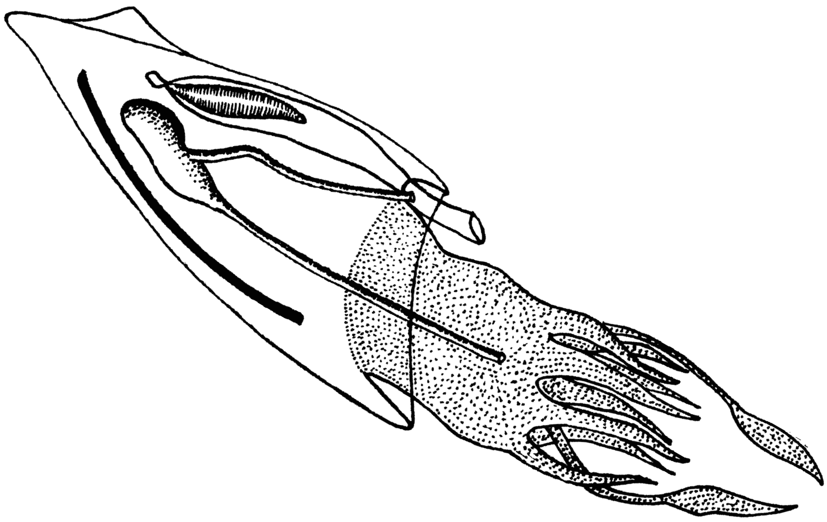


Figure 58.2 Squid internal features
Wet Paper

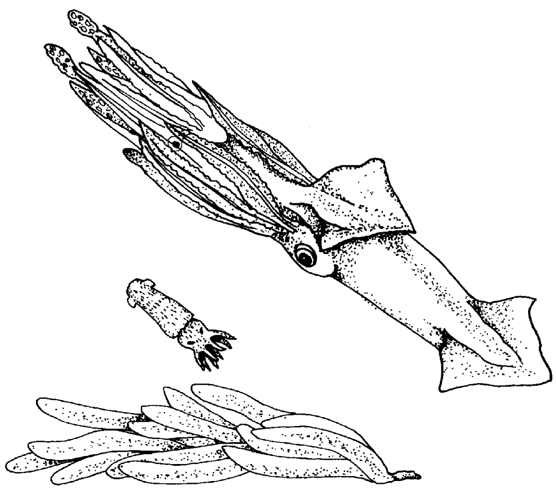


Figure 58.3 Squid life cycle (After Neilsen 1982)
Wet Paper

Exercise 59
Crabs

Read the conservation section on Looking at marine life in Exercise 52 before you do this activity.

Method

1. Make sure your aquarium is full of clean fresh seawater.
2. Very carefully place a small swimming crab in the aquarium and carefully observe how it moves.

   Be very careful with your crab as the legs are designed to break off if they are trapped and the crab needs to get away.
3. Turn to your textbook Page 469 of and locate the following external features:
   - chela
   - eye stalk
   - antennae
   - carapace
   - coxa
   - swimmerette
   - walking legs 1 - 3
   - coxa
4. Wait for the crab to come up close to the side of the aquarium and have a careful look at the mouth and mouth parts.

   Using the illustration in your textbook Page 469, identify the mandibles and mouth.

   Can you see these moving? Make a description in your notebook.
5. Look carefully at the cooked crab and identify the gastric, branchial, hepatic and cardiac regions.

   Mark these in Figure 59.2.
6. When you have finished with your crab, very carefully return it under the directions of your teacher.

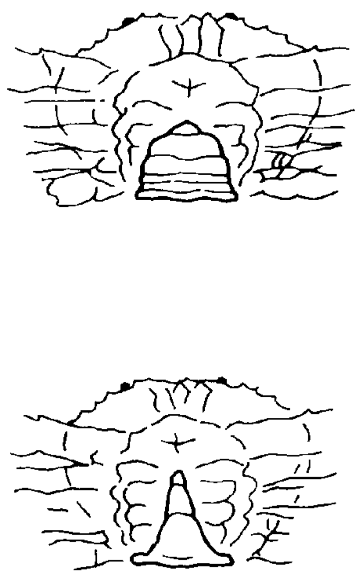


Figure 59.1 Sex the crab
Wet Paper

Questions

1. Identify the male and female crabs in Figure 59.1.
2. What does the term dorso-ventrally flatterned mean and of what significance is this to crabs?
3. Make a copy of Figure 59.4 and use your textbook Page 406 to make a description of the life cycle of a crab.

Materials and equipment (per group)

- a small swimming crab
- small aquarium with fresh sea water
- large cooked crab

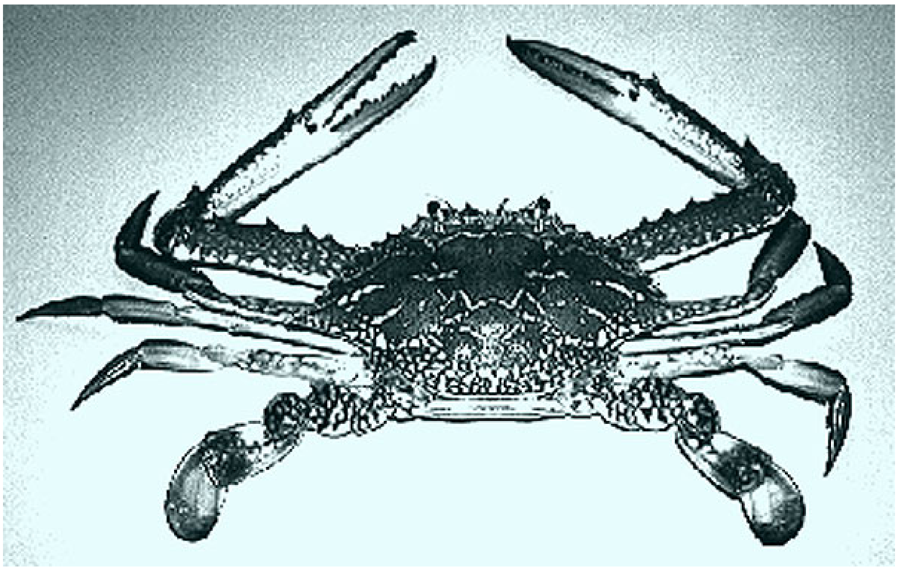


Figure 59.2 Crab external features, dorsal view

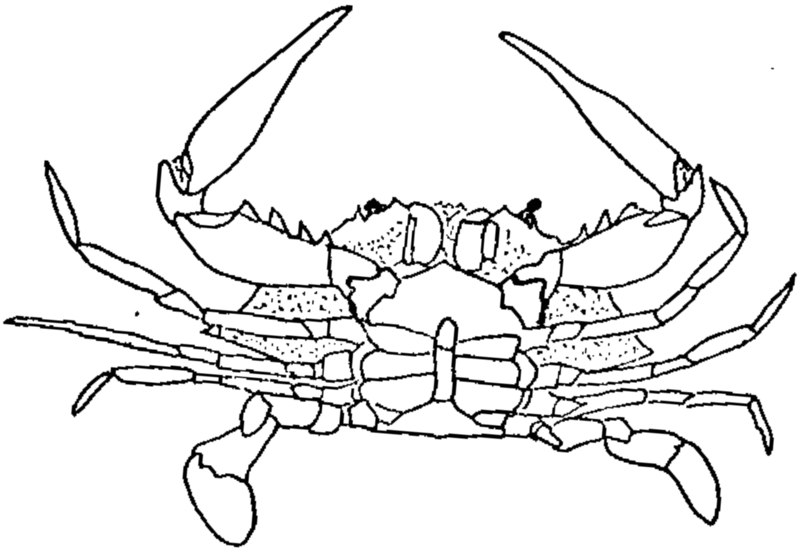


Figure 59.3 Crab external feature, ventral view (Illustration by Mark Moffatt)

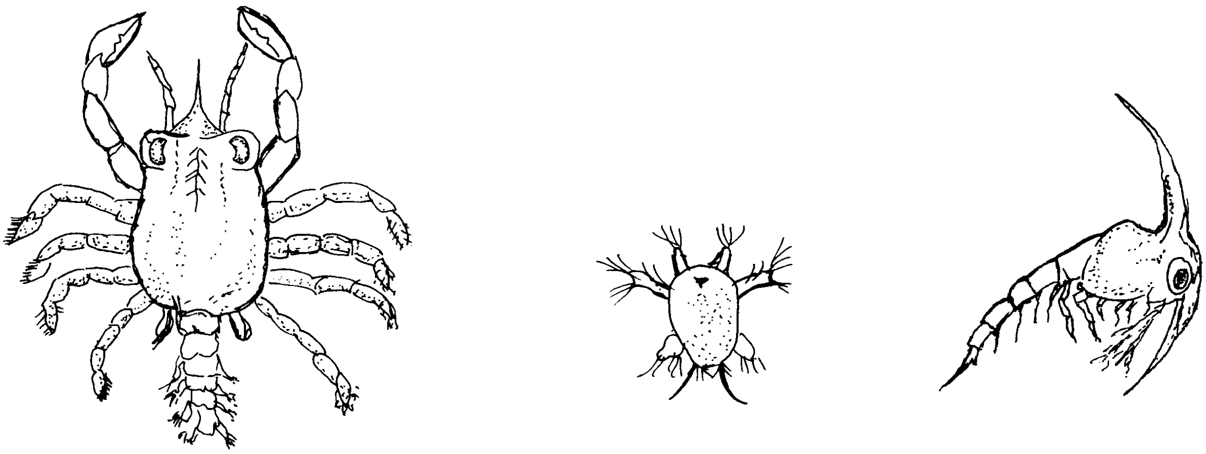


Figure 59.4 Crab life cycle (Illustration by Meran Kilgour)

EXERCISE 60
ROCKY SHORE ECOSYSTEM STUDY

METHOD

Discuss Figure 60.1 in class. Now read the following method and decide as a group how you will plan a rocky shore excursion.

1. One way to study a rocky shoreline is to make a systematic study using a transect method.
2. Look back to Activity 17 (Page 38) and Activity 47 (Page 106) to see how to construct a profile with a metre rule and conduct a transect with a sample metre square.
3. At a preset number of points, say ten, detailed measurements are taken at places called **sample stations** shown in Figure 60.2.

   As time will be a constraint, measurements to be made will be done by groups who have practised their techniques well before the study.

   Abiotic features could include those you have practised in Chapter 13 of your textbook such as dissolved oxygen, temperature, pH, salinity, nutrients and turbidity plus wave and wind action measurement parameters and estimations of tidal influences.
4. Once you have your profile data and sample data (see Figure 60.3) you will need to work out the distribution and abundance of animals and plants.

   a. To work out the distribution of organisms you need to count the organisms at a sample site or station. The transect square is used to do this and if there are too many in the square to count, a 100 mm x 100 mm subsampler square can be used (as is used to count barnacles).

   b. After you identify and count all the individuals, you then decide on the dominance of the individuals.

   You could use the following, or you may wish to design your own:

   - dominant – the greatest number in the square
   - co-dominant – approximately equal numbers
   - sub-dominant – significantly less
   - not-dominant – one or two
   - absent
5. From this information you draw kite diagrams (see Figure 60.4) on your profile to show how the pieces of information you are collecting fit together. You will need a big sheet of graph paper (see Figure 60.5) and decide on the number of squares for the dominance (i.e. 1 mm = not dominant, 2 mm = sub -dominant etc.)
6. Next add the abiotic data by following the techniques described in your textbook Chapter 13. You should be able to estimate temperature and dissolved oxygen in the field and take back samples for biological oxygen demand, salinity, pH, total solids and nutrient analysis.

   These are added to the profile to establish relationships and make comparisons.
7. The next activity looks at drawing a food chain.

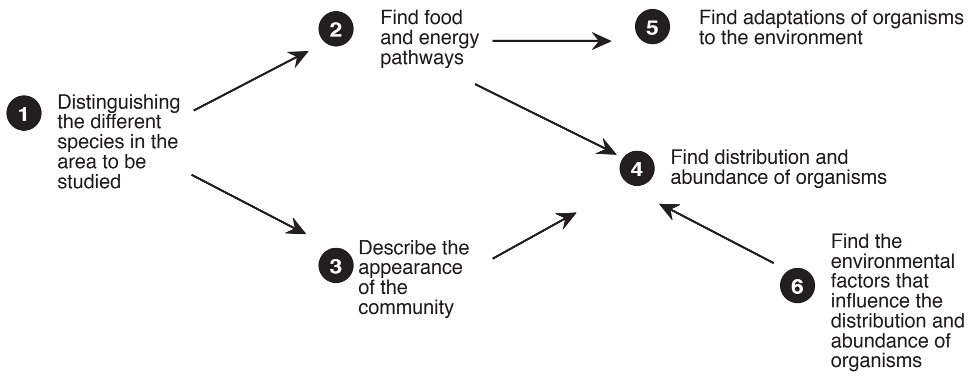


Fig 60.1 One approach to study a rocky shore (Womersley and Edmunds (1958) in Above and Below High Water, SA Ed. Dept. Reproduced with permission)
Wet Paper

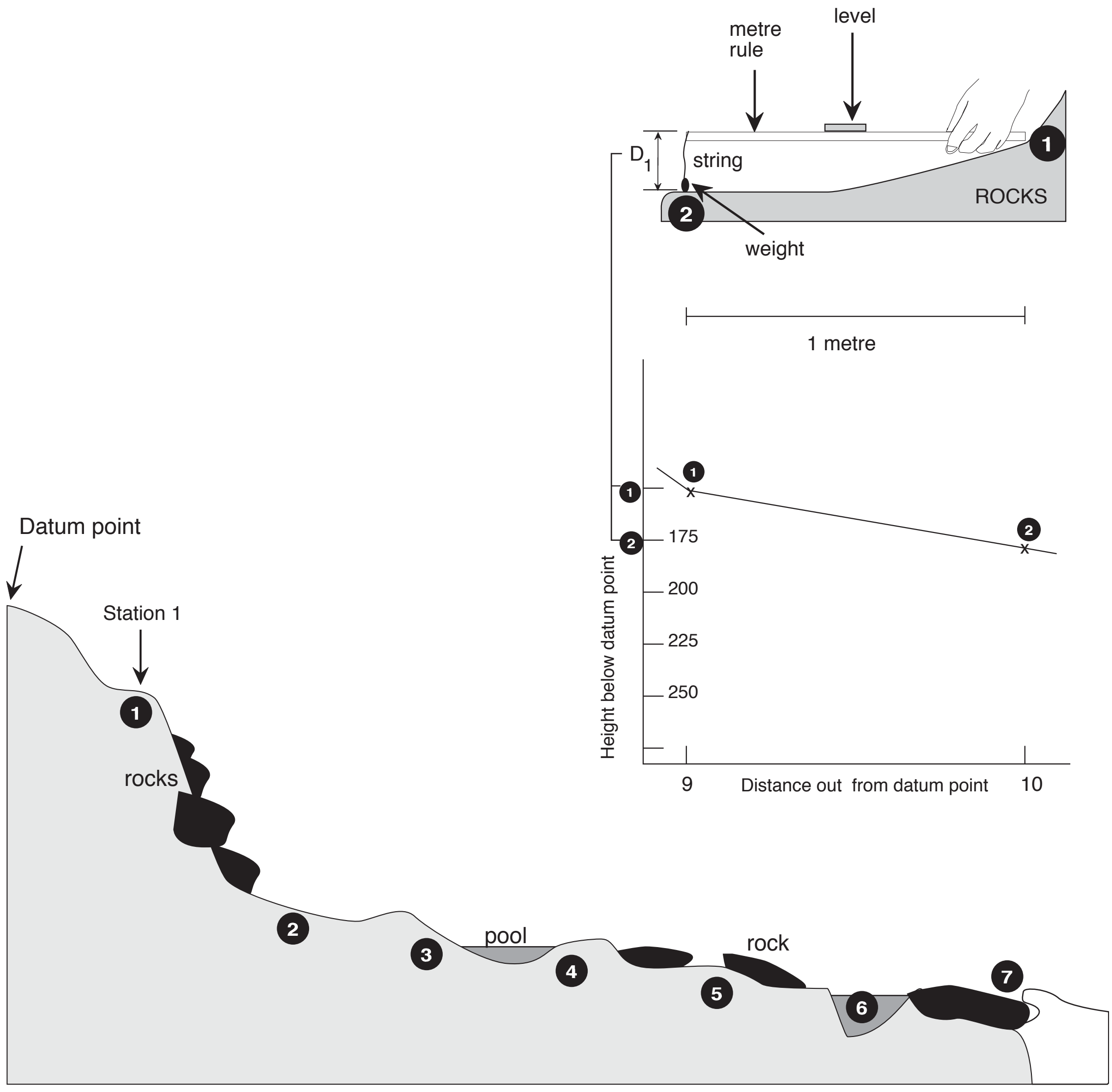


Fig 60.2 Measurements are taken at sample stations
Wet Paper

Data sheet

Station No 5

Species present	No counted	Dominance
Limpet	7	Sub Dominant
Periwinkle	35	Dominant
Chiton	1	Present
Algae	80%	Co-dominant
Limpet	7	Sub Dominant

Water temperature	28 ^oC
D.oxygen	4 mg/L
Salinity	38 mg/L
Turbidity	4 m
Wave action	Low tide - nil, high tide - exposed
Wind action	Fully exposed
Nitrates	.62 mg/L
Phosphates	.04 mg/L

Figure 60.3 Sample data sheet

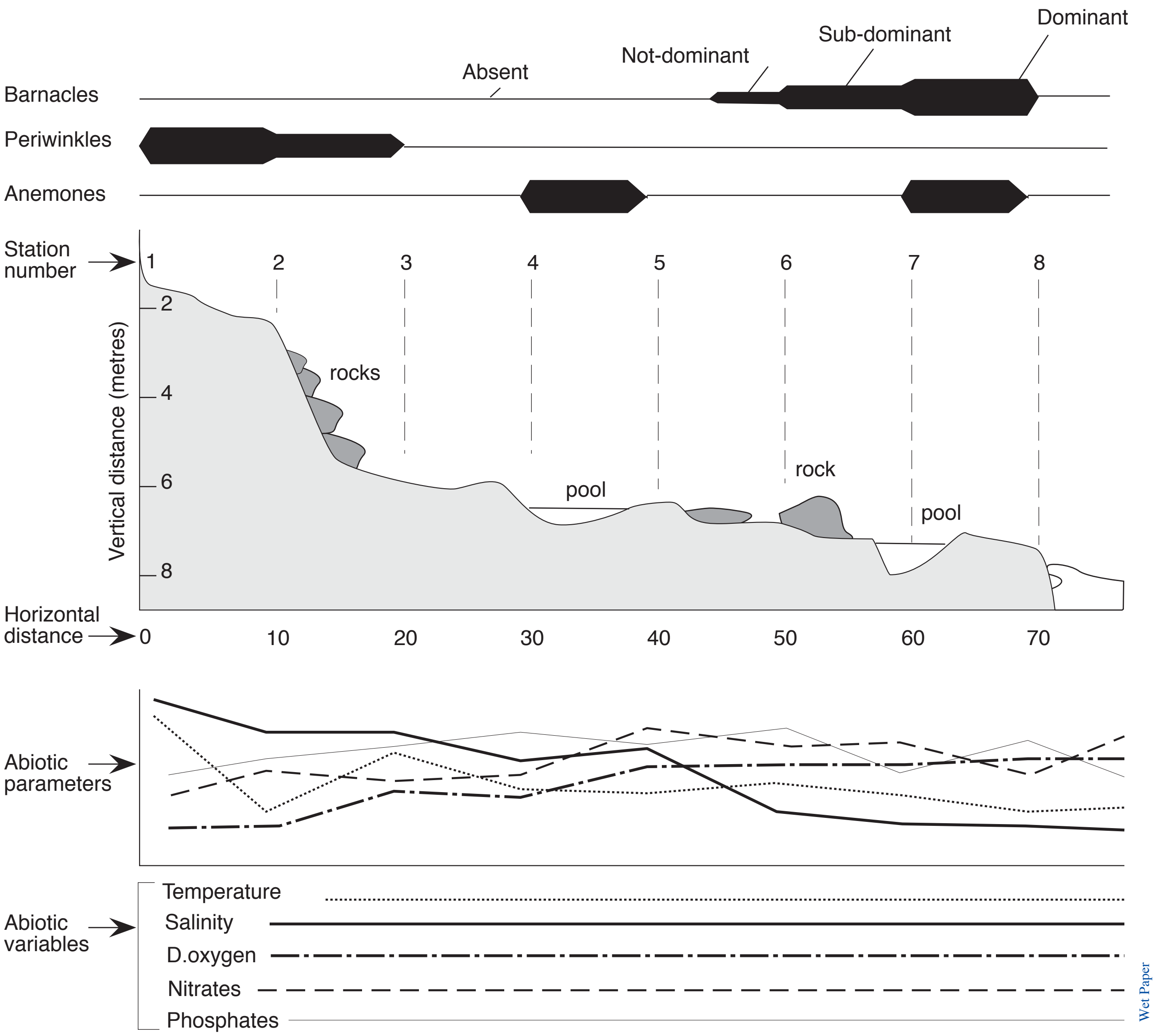


Figure 60.4 Presentation of information about your ecosystem (Kite diagrams based on original university notes 1972 in a lecture series by Tom Hailstone)

Figure 60.5 Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet.

Exercise 61 Drawing food chains

To establish what eats what, you have to trap and kill the predators; watch the predators feed; or trap and make them regurgitate their food.

Please use only the observation method and leave the others to persons researching their work in order to preserve our environment.

Method

1. Turn to textbook Page 504 and locate Figure 22.

   Now complete exercise Figure 61.1 using the Pope and McDonald method for drawing a food chain for the following animals:

   - sea weed
   - diatoms
   - barnacles
   - oysters
   - copepods
   - cartrut shell
   - sand hopper
   - dead remains of animals
   - fish
   - sea anemone
   - tube worm
   - oyster borer
   - algae on rock
   - chiton
   - bream
   - red algae
   - sea squirt
   - periwinkle
   - octopus
   - sea gull
   - flatworm
   - hermit crab

2. Now work on the information you have collected from the past activity and complete a food web for your rocky shore in Figure 61.2.

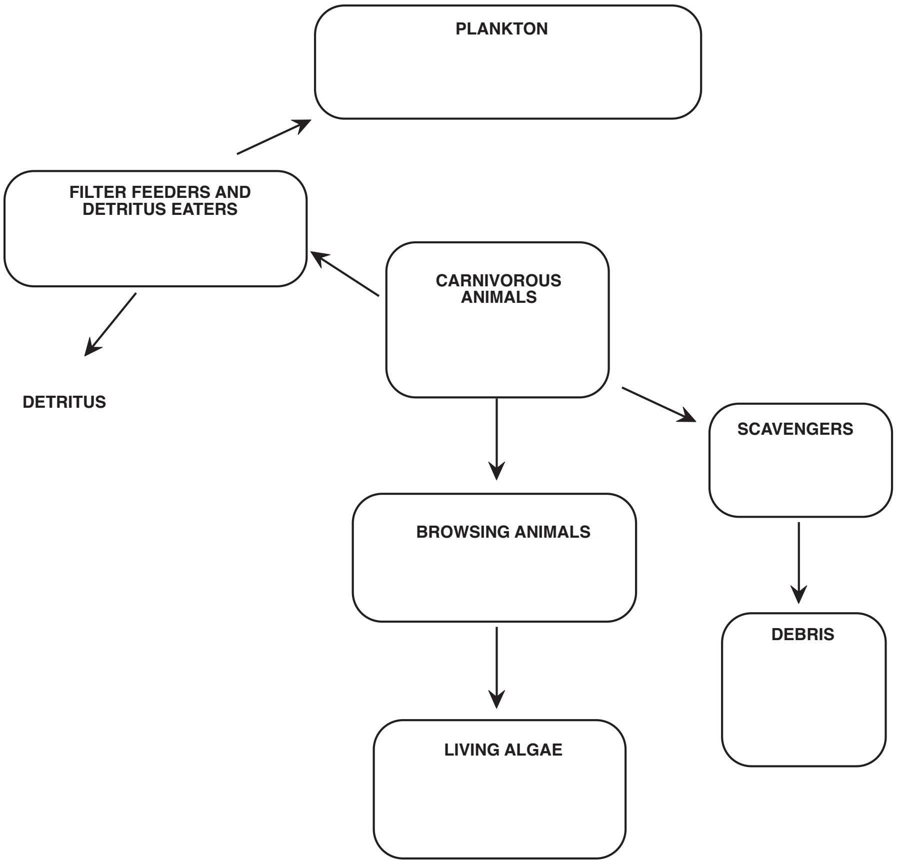


Fig 61.1 Food relationships of animals on the rocky shore (Pope and McDonald (1968) in Below High Water. SA Department. Reproduced with permission)
Wet Paper

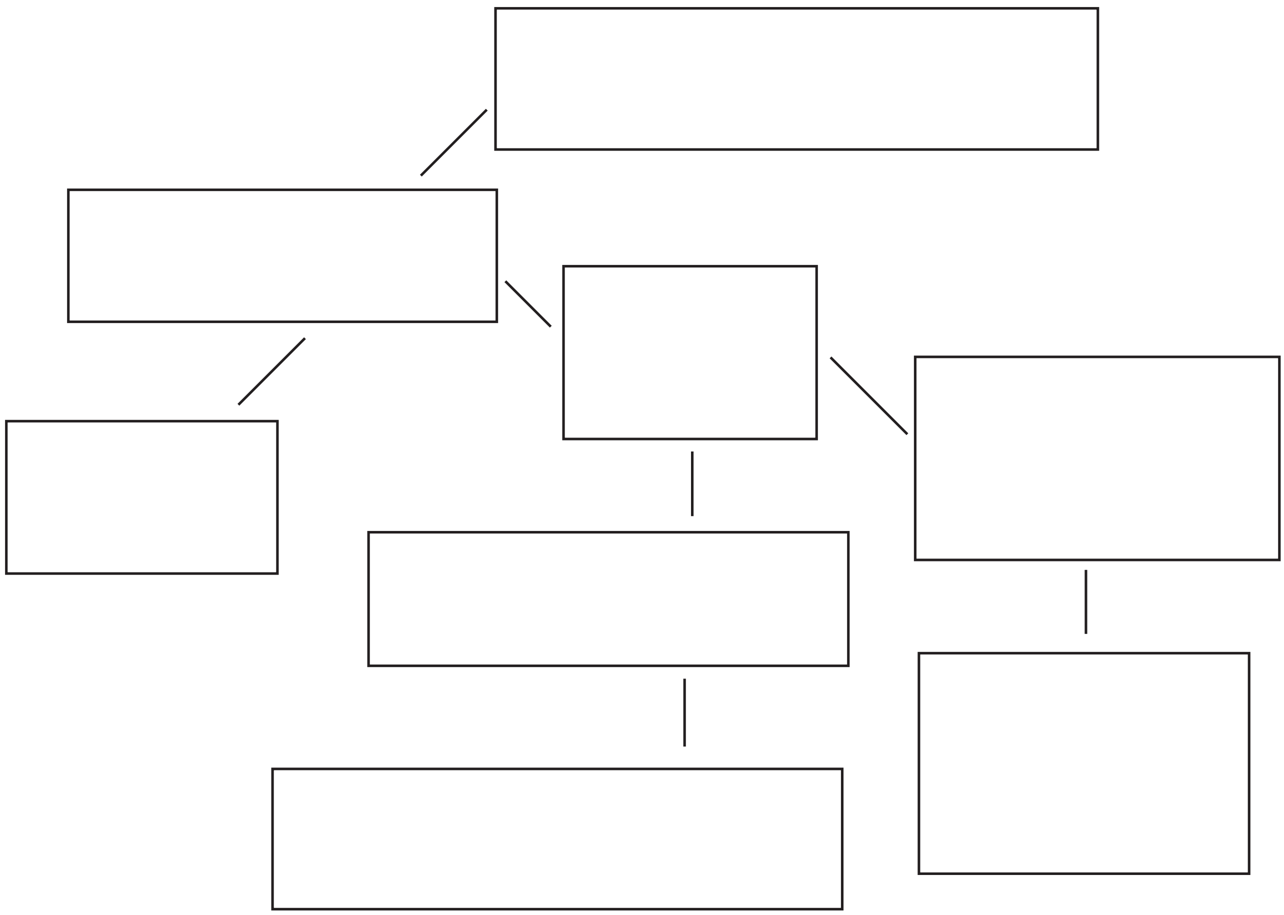


Fig 61.2 Food chain for your data from Exercise 60
Wet Paper

Exercise 62
Marine Ecosystems

Based on an original exercise by Tim Ryan, Maryborough State High School

Questions

Complete this exercise after reading Chapter 17 of you textbook.

1. Define the terms and give an example of each
   - ecosystems
   - habitat
   - productivity
   - biological succession
2. Complete Figure 62.1 by listing some of the biological, physical and chemical variables discussed in the chapter.
3. Now list some of the adaptations aquatic organisms make to overcome each of these problems.
4. Complete Figure 62.2 by listing some important physical factors found in each of the ecosystems listed giving a typical producer and typical animal from each
5. Write a summary paragraph on four relationships that could exist between abiotic and biotic conditions in the ocean and how animals and plants have adopted to those conditions.

Components of the environment

Biological biotic variables	Physical abiotic variables	Chemical abiotic variables

Figure 62.1 Components of the environment

Some Australian Ecosystems

Ecosystem	Important physical factors	Typical producers	Typical animals
Rocky shore			
Reef			
Mangrove			
Mud flat			
Coastal dune			

Figure 62.2 Some Australian ecosystems

Exercise 63
Adaptations

Based on an original exercise by Tim Ryan, Maryborough State High School

Questions

Read the passage in Figure 63.3 and study the illustrations in Figures 63.2 and 63.4 and answer the questions below.

1. Circle the words in the passage in Figure 63.3 that tells you that there are differences between the flounder and the bream.
2. Make a list of those contrasting signal words.
3. The table in Figure 63.3 represents the differences between the two types of fish. Use the information in the passage to complete the table.
4. Write a paragraph composed of five sentences. These sentences must show the differences between the flounder and the bream.
5. Using the words sea urchin spines, worm, mouth of long nosed butterfly fish and laterally flattened, write a paragraph in the space under Figure 63.4 describing how this fish's adaptations are different from the other two described in this exercise

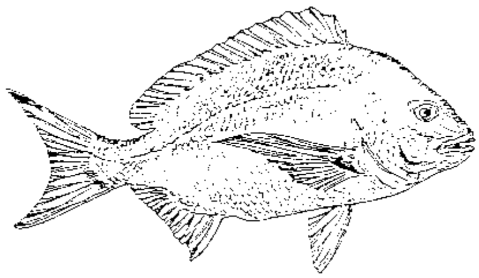


Figure 63.1 Bream
Wet Paper

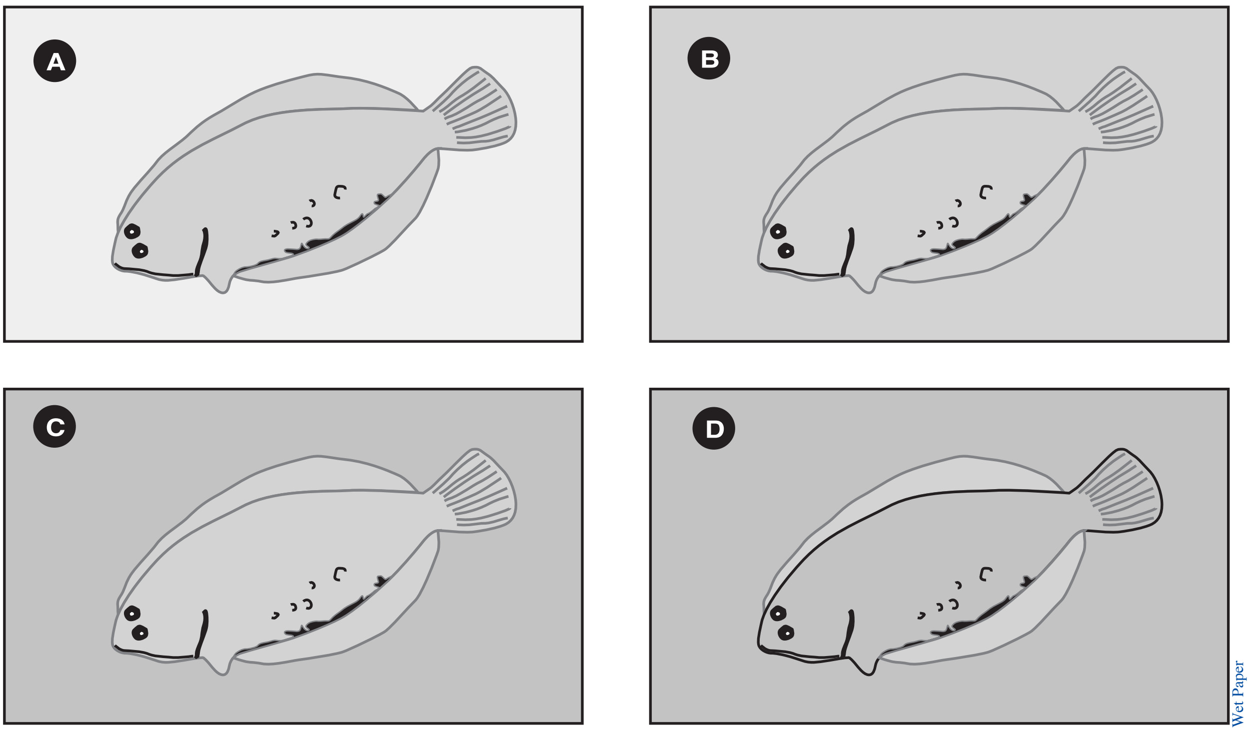


Figure 63.2 Flounder on the sea floor

Flounder

Each particular organism has its own living place - this is called a habitat. In a salt water river, the habitat of a flounder is on the river bottom. The flounder is not a strong swimmer so it does not have well developed muscles. To protect itself from enemies, it lies flat on the sand or mud of the river bottom. Both eyes are on the one side of its head whereas other fish have one eye on each side of their heads. These characteristics, which make the flounder survive well in its habitat, are called adaptations.

The flounder also has another adaptation that increases its chances of survival. It can change its skin colour and pattern to blend in with its background. When the fish is on the sandy bottom (Figure 63.2A), its colour is light, but when on a rocky bottom its pattern changes. It becomes blotchy and much more black and white (Figures 63.2B, C and D).

The bream if found in the same river but has different adaptations (Figure 63.1). It also has a different habitat. The habitat of the bream is the open water of the river. Unlike the flounder, the bream is a strong swimmer. It has a very smooth, streamlined body and the body muscles are strong and well developed. The eyes of the bream are much larger than those of the flounder. This is because the bream catches food on the move.

The bream is a silver–white colour. This colour tends to hide it in the flickering light of the river waters. This compares with the flounder's dull brown and often speckled or spotted colour , which provides camouflage on the river bottom.

If the bream and the flounder swapped habitats, they would become easy prey for predators.

Feature	Flounder	Bream
habitat		
		strong swimmer
	both eyes on one side of the head	
body muscles		
		large eyes
	dull brown body	
body pattern		

Figure 63.3 Information and table on flounder

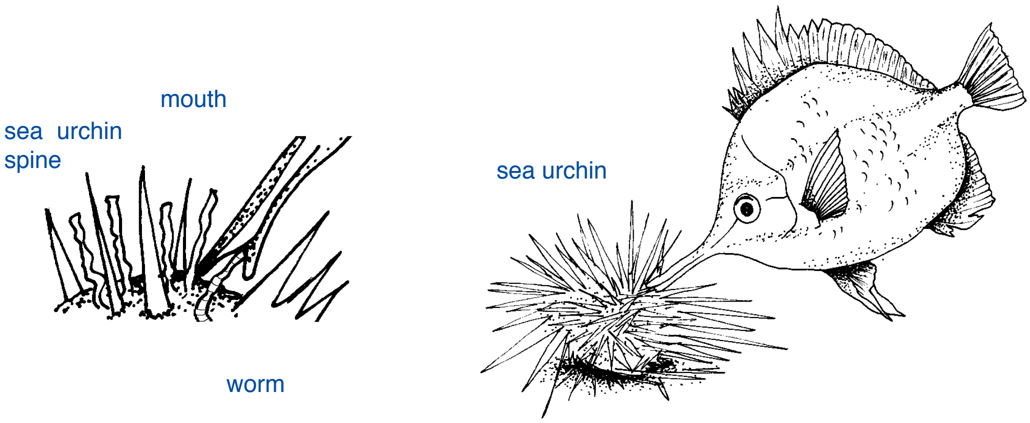


Figure 63.4 Long nosed butterfly fish and sea urchin
Wet Paper

Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 64
Phytoplankton

Questions

In your textbook find Chapter 14 Plankton.

1. New plankton have been found and identified under the microscope as shown in Figures 64.1A and 64.1B.
   a. Use your text to predict which could be the diatom and which the dinoflagellate? Give reasons for your answer.
   b. Mark in the most likely structure that represents a flagellum.
   c. Use your text to identify the vacuole, plate made from silica and chromatophore in diatoms and then predict where these most likely would occur in Figure 64.1.
2. Use your textbook to identify each the phytoplankters in Figures 64.2 A, B, C and D. Use scientific names where possible.
3. Which of the phytoplankters identified in Figure 2.2 are diatoms and which are dinoflagellates?
4. What separates a dinoflagellate from a diatom?
5. Figure 64.3 shows a special type of algae. What type is it and what special event does it cause?
6. Study Figure 64.4 and use your text to complete the missing words.
   a. Distinguish between the photoic zone and aphotic zones.
   b. Predict where photosynthesis would most likely occur
   c. Describe the relationship between the fish and the phytoplankton
   d. What would be the effect if pollution from the estuary killed all the fish?
7. Where does approximately 80% of the world's oxygen come from?
8. Write one paragraph on any three of the following topics
   a. bioluminescence
   b. ocean colour
   c. planktonic blooms
   d. ciguatera
   e. commercial applications of diatoms

Research assignment

Some species of dinoflagellates have been used to identify where undersea oil deposits are.

What types are these and how are they used to find oil and gas?

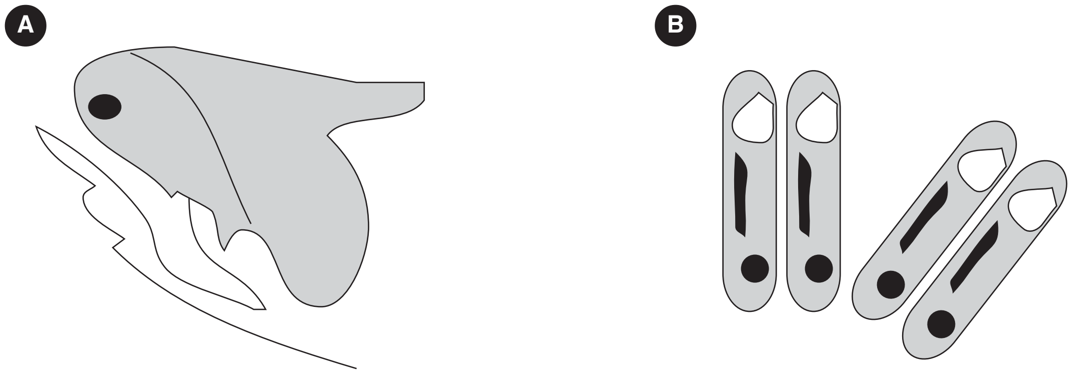


Figure 64.1 Plankton seen under a microscope at x 100
Wet Paper

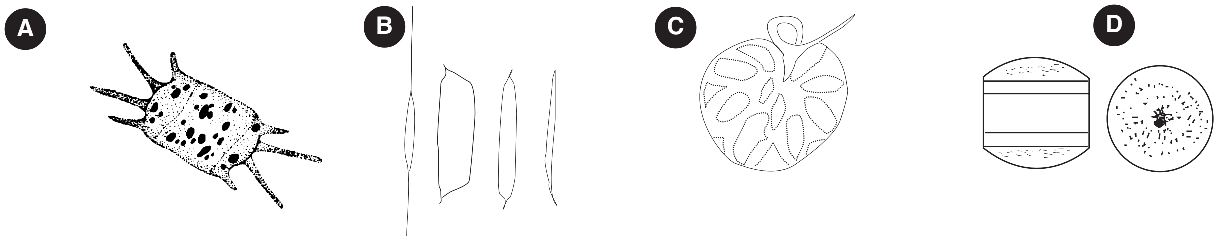


Figure 64.2 Four types of phytoplankton
Wet Paper

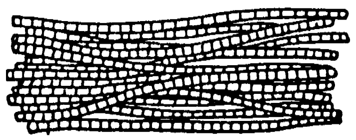


Figure 64.3 A special type of plankton
Wet Paper

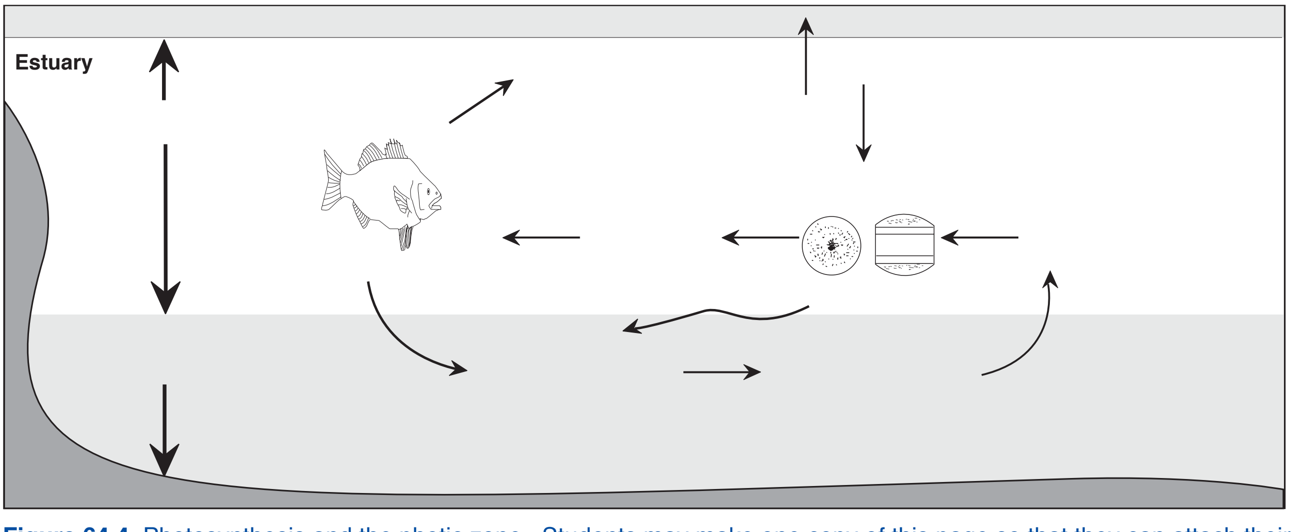


Figure 64.4 Photosynthesis and the photic zone. Students may make one copy of this page so that they can attach their answers before handing in for marking.
Wet Paper

Exercise 65
Seaweeds

Questions

In your textbook Page 465, locate the term Thallus in the Seaweeds section.

Use the text in Figure 65.1 to complete the sentences in Figure 65.2

Note: A cloze exercise is where you are asked to locate a block of text from your textbook and fill in the missing words. The idea is that you learn new words by reading carefully selected sentences. You also learn how to use your index.

Seaweeds

The proper name for seaweed is algae. Not all algae, however, are seaweeds as some live in fresh water and on dry land. Not all marine algae are seaweeds because microscopic algae are called plankton and only the marine algae large enough to be seen without the use of a microscope are called seaweeds.

Groupings

Seaweeds are grouped according to their colours:

1. Green algae, Chlorophyta, includes the green seaweeds.
2. Brown Algae, Phaeophyta, includes the brown coloured seaweed and the large kelp.
3. Red algae, Rhodophyta, include the red seaweeds and also with other combinations.

Algae commonly have a holdfast, located at the base of the plant to which is connected a stipe.

A number of leaf like structures are connected to the stipe called blades

Seaweeds are an important part of the ocean community. Animals such as nudibranches, snails, and crabs live on the blades. Starfish, clams, crabs and worms seek shelter among the holdfasts. Some small fish and crabs that are the same colour as the seaweeds hide there from predators. In addition to providing shelter, seaweeds also provide oxygen for these marine animals.

The seaweed therefore has the adaptation of having a holdfast to prevent it from being washed away, a reproductive cycle with both sexual and asexual stages to increase its chances of survival, green pigments which enable it to make its own food, a long thin shape to stop it being covered by mud, and specialised floating cells to keep the shoots upright in the water.

Figure 65.1 About seaweeds

CLOZE EXERCISE

1. Floating ________________________ do not have roots, stems and leaves as land plants do.
2. The entire body is called a ________________________.
3. Seaweeds that are attached have a thicker root-like or foot-like portion called a ________________________.
4. Instead of leaves or stems , some seaweeds have a stem-like area called the ________________________ , and a leaf like area called a ________________________ .
5. Most seaweeds have a holdfast, stripe and a blade, although they may be hard to distinguish on many plants. Green plants reproduce by forming flowers, which in turn produce seeds, however seaweeds produce ________________________ on the tips of their branches.
6. These spores are very tiny, and when released, float away to become part of the great mass of floating ________________________ .
7. Use Figure 65.2 to write a description of how a seaweed reproduces. Distinguish between the asexual and sexual stages and draw in the place where the juvenile would grow.
8. How do seaweeds help animals such as starfish, clams, crabs and worms?

9. Name one adaptation of a seaweed giving a reason for your answer.

10. Why do some species of seaweeds have air bladders?

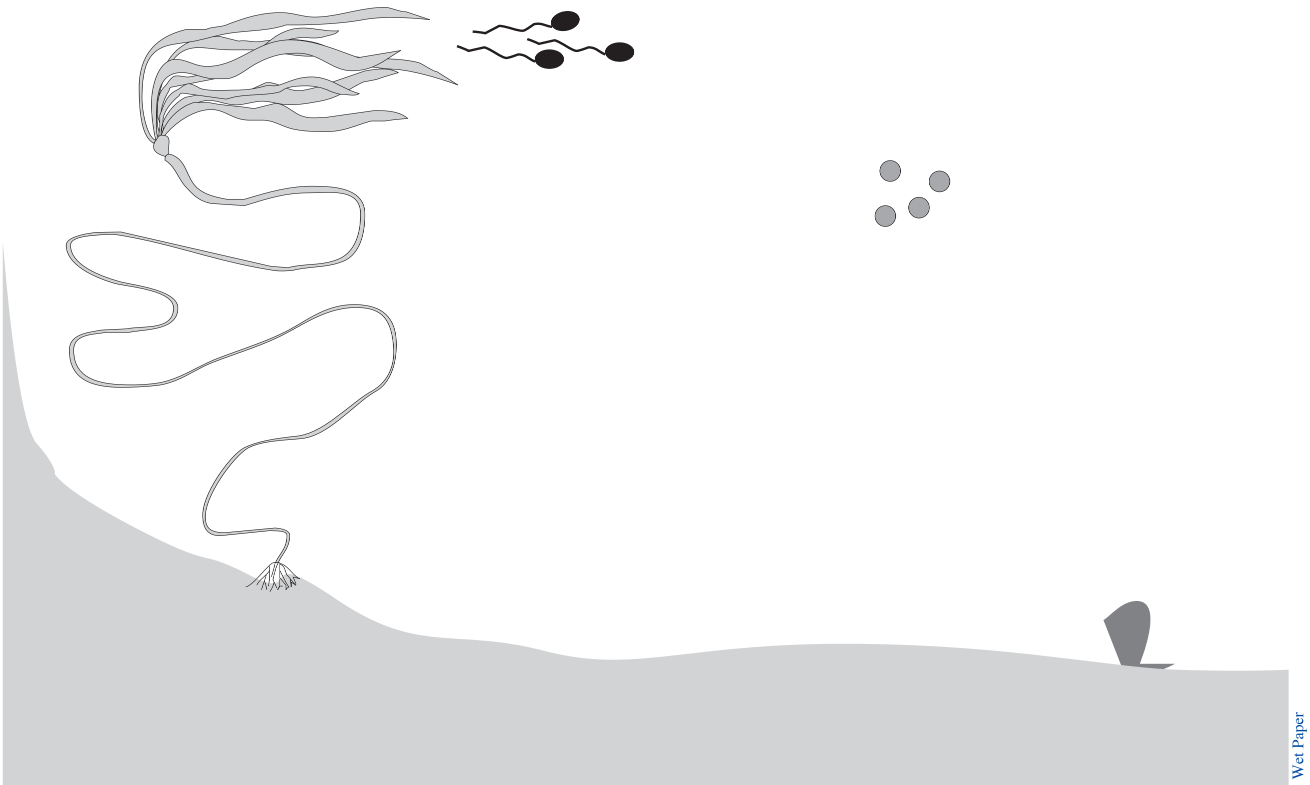


Figure 65.2 Algae reproduction. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 66 Adaptations of fish

Questions

1. Turn to your textbook Page 433 and complete Figure 66.1 to show how this fish reproduces.
2. Fish have a number of other adaptations. Research at the library to discover fish which have the adaptations listed in Figure 66.2.

   Classify the adaptation as structural, functional or behavioural and record your answer in this table.

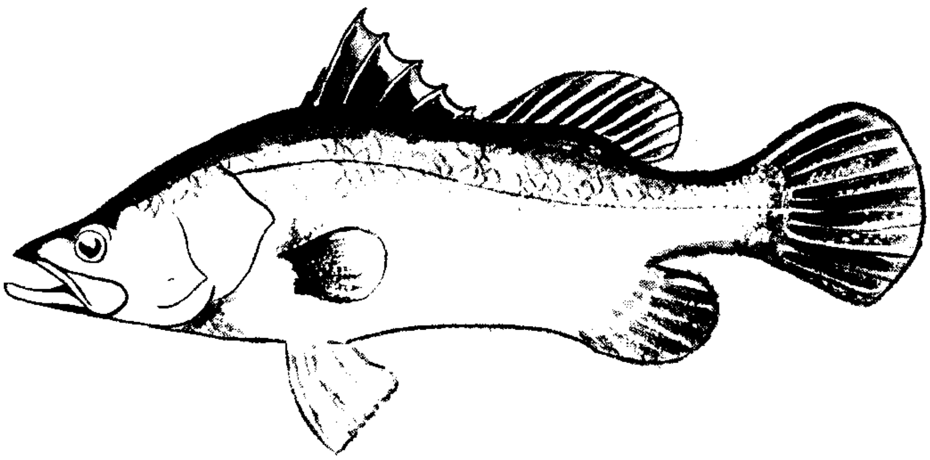


Figure 66.1 Fish reproduction adaptations. Students may make one copy of this page so that they can attach their answers before handing in for marking.
Wet Paper

Adaptation	Type: behavioural, structural or functional	Benefits	Fish having this adaptation
Sex change			
False eye spot			
Coverage of slime			
Venemous spines			
Poisonous fish			
Peripheral vision			
Schooling			
Muscous shield			
Amour			
Camouflage			
Remove salt from body			
Barbets			

Figure 66.2 Fish adaptations table. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 67
Streamlining

Method

Part A

1. Three-quarters fill the graduated cylinder with water.
2. Drop each of three shapes as shown in Figure 67.2 down through the water column.
3. Make careful observations and record which shape travels the fastest through water.

Part B

1. Set up a streamlining tray as shown in Figure 67.3.
2. Run water through the tray.
3. Make careful observations and record which object appears to create the greatest drag.

Questions

1. Which shape is the best for swimming through water quickly.
2. Name any four fish that are shaped this way.
3. Fast swimmers usually have forked caudal fins. Why is this?
4. Make up a table for the fish shown in Figure 67.1 showing where the fish could live and which would swim the fastest.

Equipment and materials (per group)

- measuring cylinder
- different shaped objects as shown in Figure 67.2
- streamlining tray and plastic shapes as shown in Figure 67.3

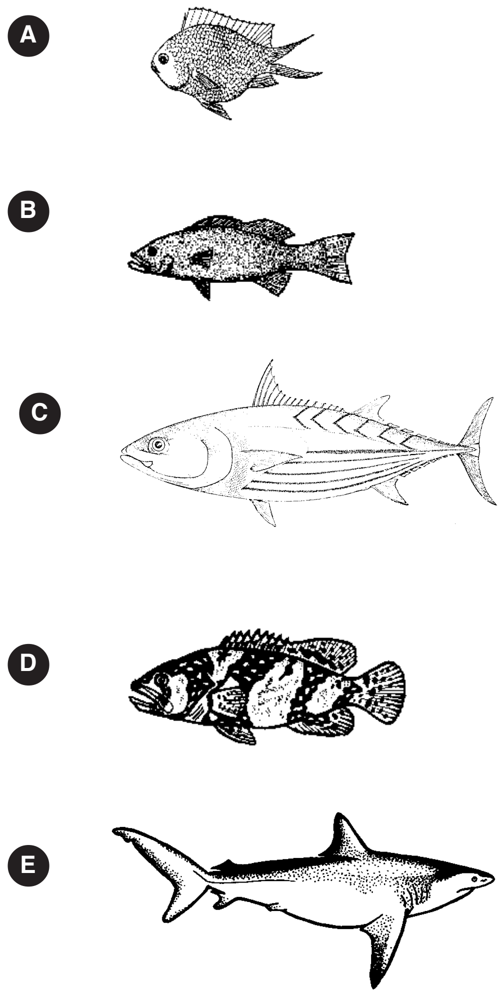


Figure 67.1 Common reef fish
Wet Paper

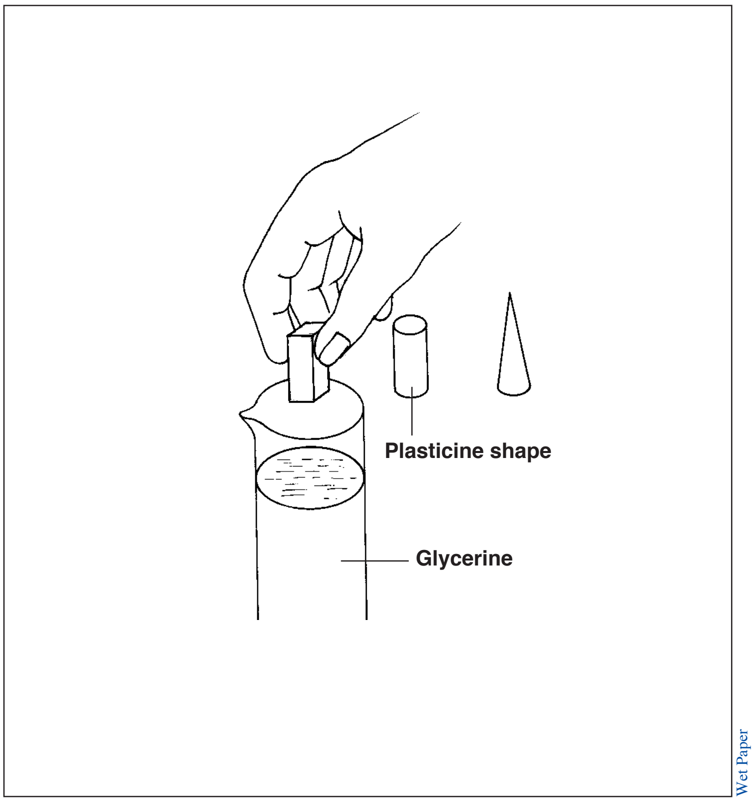


Figure 67.2 Observe the objects speed through the water

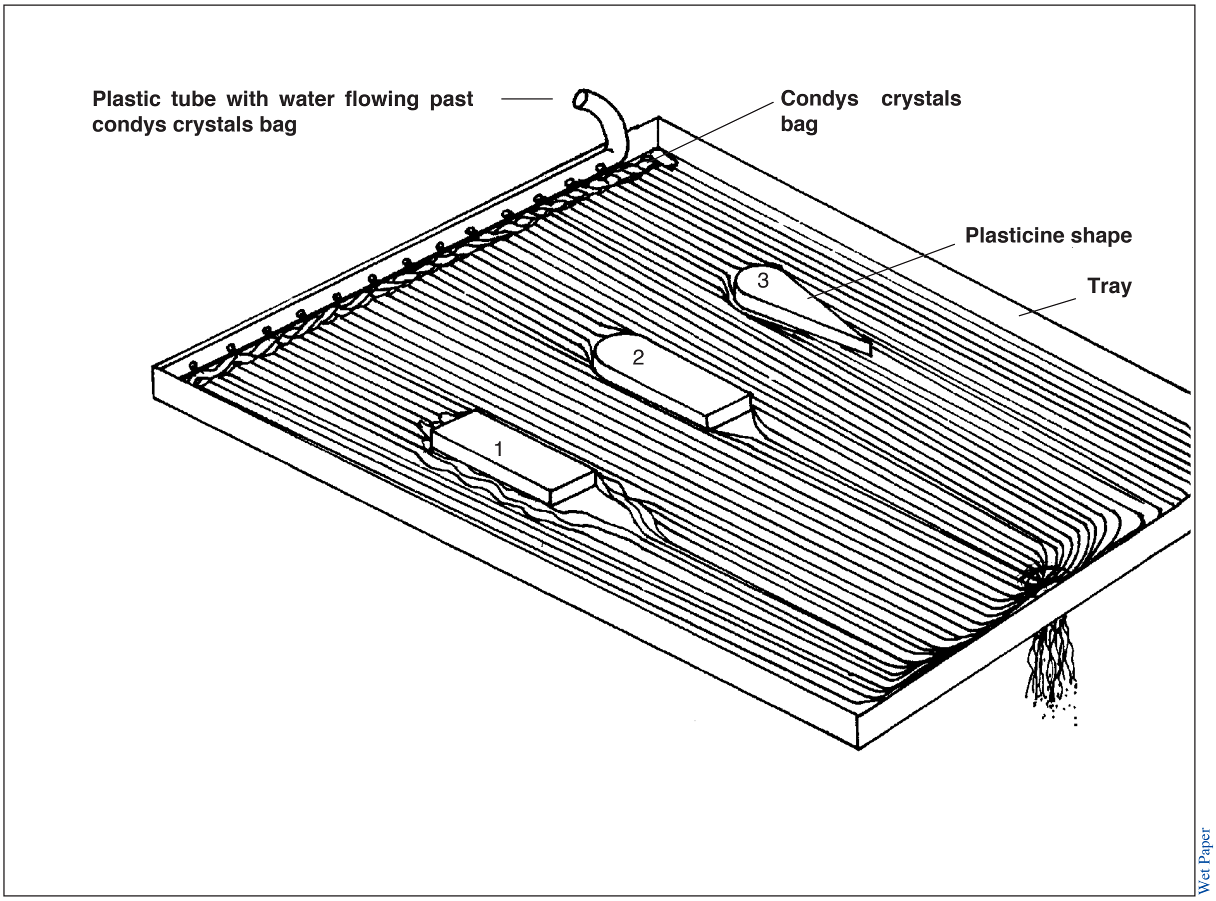


Figure 67.3 A streamlined shape shows least drag (Source of illustration unknown)

Exercise 68
Viscosity

Based on an original activity by Tim Ryan, Maryborough State High School

Method

1. Using stand and clamps, set up the 4 pieces of glass tubing in a vertical position.
2. Cork each glass tube as shown in Figure 68.1.
3. Fill each glass tube to an approximate height of 25 cm with one of the liquids below. The liquids in each tube should be of the same height.
4. Release a sphere into a filled tube and record the time it takes to reach the bottom.
5. Repeat step 4 using the other three liquids.

Questions

1. In which liquid did the sphere take the longest time to sink?
2. How long did it take the sphere to reach the bottom of the glass tubing?

   How long will it therefore take for it to sink 1 metre?
3. How long will it take for the sphere to sink to the bottom of the Pacific Ocean which has a mean depth of 4188 metres?

Materials and equipment (per group)

Equipment required

- honey or golden syrup
- clear oil (motor oil)
- cooking oil
- 4 metals or heavy spheres (marbles/sinkers will do)
- 4 lengths of glass tubing 30 cm, (the wider the better).
- 4 large test tubes mat be used (the sphere must fit inside the glass tubing)
- 4 corks to seal glass tubing
- stand and clamps

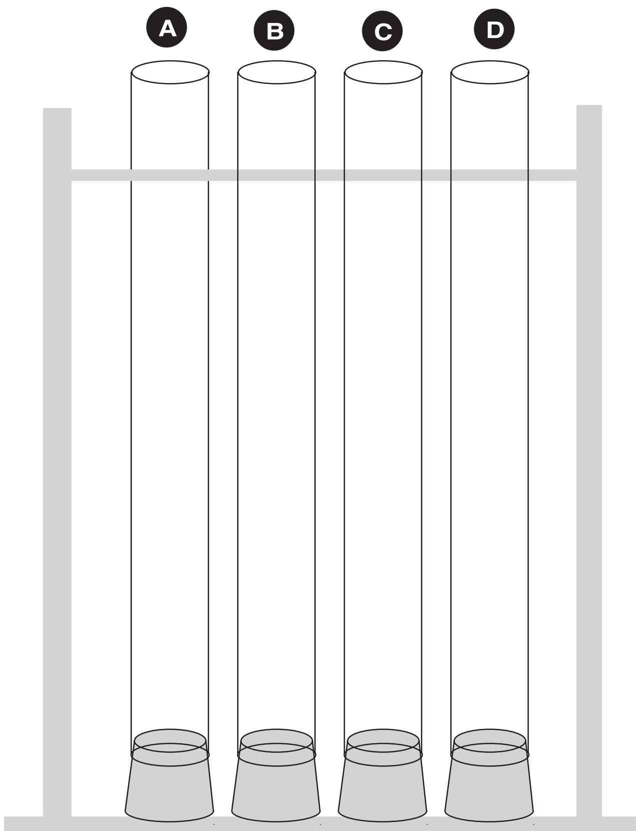


Figure 68.1 Viscosity experiment
Wet Paper

Exercise 69
Buoyancy

Based on an original activity by Tim Ryan, Maryborough State High School

Method

1. Remove a portion of an aquatic plant from water and observe its appearance.
2. Replace it in the water and observe its appearance.
3. Remove the gills from the fish and observe their appearance in and out of the water.
4. Using a spring balance find the weight of a bolt (or heavy object) in air.
5. Weigh the same object when it is submerged in distilled water.
6. Weigh the same object when submerged in salt water.
7. Repeat steps 4,5 and 6 using another object.

Questions

1. What was the difference in appearance of the aquatic plant in air compared to its appearance in water.
2. What was the appearance of the gills in and out of the water?
3. What was the weight of the bolt:
   a. in water?
   b. in air?
   c. in salt water?
4. Would an animal require more internal structures in air or water? Explain.
5. Why would land animals have hollow bones? Explain.
6. Would a land animal be able to use gills to breathe? Explain.
7. Would an aquatic plant be able to survive on land? Explain.

For further investigation

1. Examine the vertebrae column of an aquatic animal and compare its interlocking structures to the vertebrae of a land animal.
2. Using a reference book from the library, compare the development of the limbs of an aquatic mammal such as a whale to those of a terrestrial mammal.
3. Because the dissolved minerals in sea water make it heavier than freshwater, use an hydrometer to measure the different densities.

Materials and equipment (per group)

- 1 fish - fresh and longer than 10cm
- 1 aquatic plant
- distilled water
- spring balance
- 1 bolt
- salt water
- string

Exercise 70
Density of Sea Water

Method

1. Set up your materials as shown in Figure 70.1 . Be sure the pinch clamp is in place.
2. Fill one squeeze bottle with salt water and the other with fresh water. Label **both** bottles.
3. Using the salt water bottle, fill the left glass tube to the 50 cm mark.
4. Using the fresh water bottle, fill the right tube to the 50 cm mark. Make sure the levels are really equal; this is more important than having 50 cm in the tubes.
5. Write down the water level on your note pad.
6. Carefully remove the clamp and allow the water to equalise. Check the water level again and write down your results.
7. Remove the rubber tubing from the end of the glass tube and drain the water. Clean up before you leave.

Questions

1. Record your results in Figure 70.2.
2. Which water level was lower? Higher?
3. Which water was heavier? Lighter?
4. Which is heavier (denser): the same amount of salt water or fresh water?

Materials and Equipment (per group)

- 2 pieces of glass tubing
- 1 piece of rubber tubing to fit over the glass tubing
- 2 squeeze bottles
- 1 pinch clamp
- 1 ruler or metre stick
- 4 rubber bands
- sea water
- fresh water

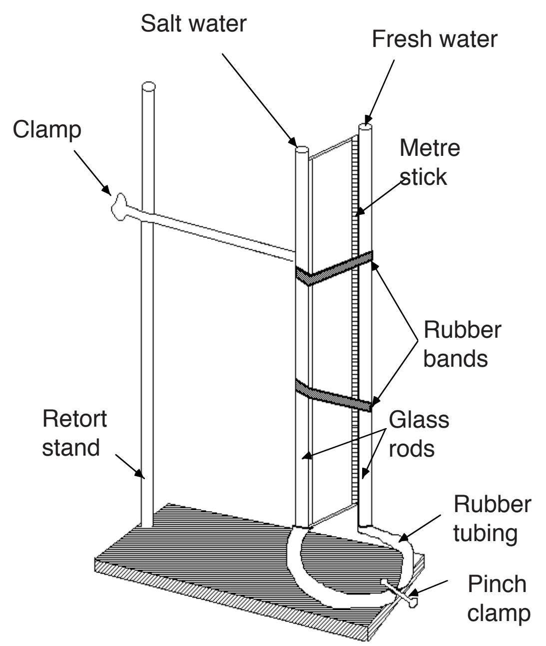


Figure 70.1 Experimental set up
Wet Paper

Results

Readings	Sea water	Fresh water
First reading (Pinch clamp in place)	____________	____________
Final reading (pinch clamp removed)	____________	____________

Figure 70.2 Results
Wet Paper

Exercise 71 What makes adaptations necessary?

Questions

1. Use your textbook Page 453, to answer the following questions:

   a. Draw lines on Figure 71.3 to the following internal organs of the dolphin:

      Tail fluke, back muscles, blubber, dorsal fin, stomach, brain, lungs, blowhole, melon, rostrum, pectoral fin, heart, liver, kidney, intestine, bladder.

   b. Waves and seawater make it difficult for the dolphin to move in water. What structural adaptations has the dolphin developed to combat this?

   c. The blow hole of a dolphin is a crucial part of the anatomy. What is this connected to and how does it help the animal survive in the sea? Use information from Figure 69 Page 454 of your textbook.

   d. Study Figure 71.2. How much faster does sound travel in water than air?

      What structural adaptations does a dolphin have to overcome this?

   e. Use the letters and space provided in Figure 71.4 A – H to make a description of how a turtle uses water to locate objects in seawater.

   f. What three senses are poorly developed in dolphins? Give reasons for your answer.

3. Read page 446 of your textbook and study Figure 71.1 to answer the following questions.

   a. How does water viscosity effect the turtles shape?

   b. The turtle lives its life in water, so why does it need a hard shell?

   c. Are plastic bags a danger to turtles? Give reasons for your answer.

   d. Hundreds of eggs are laid each year compared to one offspring of a dolphin. Why does a turtle lay so many eggs?

   e. Name a famous turtle researcher and summarise what he has to say about turtle conservation.

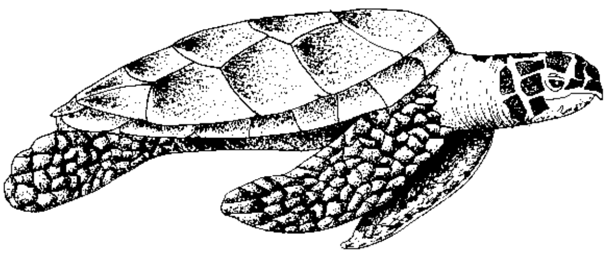


Figure 71.1 Green turtle (Illustration by Brady Moffatt)

Substance	Speed of sound
Air at 0^oC	330 metres per second
Water at 15^oC	1 450 metres per second
Granite	5 100 metres per second
Rubber	45 metres per second

Figure 72.2 Speed of sound in various substances
Wet Paper

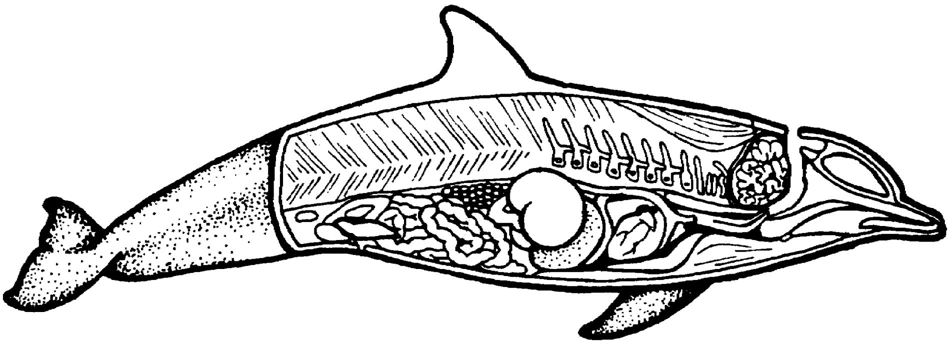


Figure 71.3 Dolphin anatomy (Illustration courtesy Sea World)

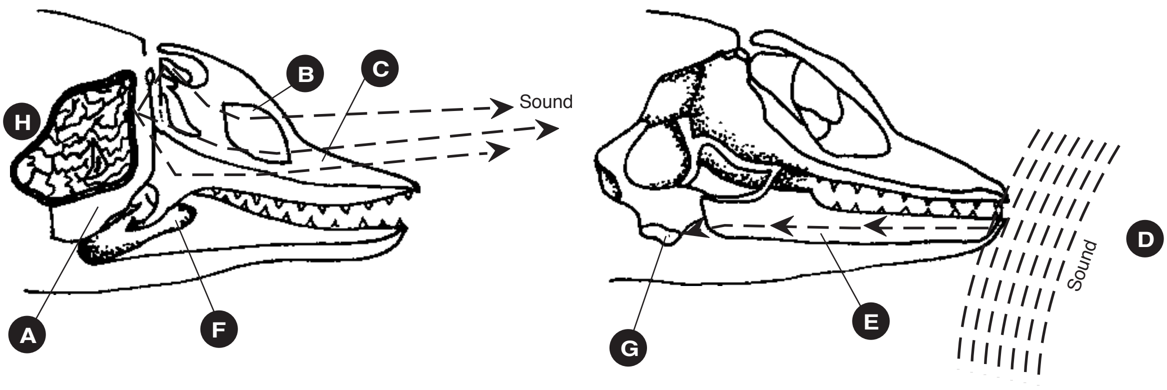


Figure 71.4 Echolocation
Wet Paper

Exercise 72 Comparing and contrasting mangroves and estuaries

Based on an original exercise by Gwen Connolly

Questions

Read the information in Figures 72.1 and answer the questions below.

1. Define the words comparing and contrasting.
2. How can a shark be compared with a ray?
3. How is a shark different from a bony fish?
4. Now use the video, Estuaries and Mangroves to identify two different habitats and write their names under the numbers 1 and 2 in Figure 72.2
5. Now compare and contrast a shark with a bony fish by examining an organisms structural, functional and behavioural adaptations to the environment from each habitat.

Materials and equipment (per class)

Video – *Mangroves and estuaries*, Part 3, by Bob Hardie

For more information about this and other Marine Biology Videos write to:

Bob Hardie Productions

PO Box 200

North Tamborine 4272

Read this

Comparing and contrasting

Comparing is concerned with pointing out the similarities and differences between things.

Contrasting concentrates on the differences.

When writing a paragraph on similarities and differences the following words should be used:

Similarities	Differences
is the same way as	different from
in the same way	dissimilar / unlike
as much as	not the same as
as many as	more. . . than
are alike	whereas
similar in that	on the other hand
in common	in contrast
have common charactersistics	but
just as	although
both. . . and. . .	although

How we express similarity sentences

1. Sharks and rays are | similar / the same / alike | in one respect / with respect to...
2. Sharks are | similar / the same / like | Rays | in one respect / with respect to...
3. Both Sharks and Rays are . . .
4. Sharks like Rays are . . .

How we express contrasting sentences

1. Sharks . . . . | but / while / whereas / however / in contrast | Boney fish
2. On the one hand, Sharks . . . . . Boney fish, On the other hand,

There are many varying habitats in the oceans each containing their own organisms, specifically adapted to that environment.

Wet Paper

Figure 72.1 Comparing and contrasting sharks, rays and fish

Features	Habitat 1	Habitat 2
Structural		
Functional		
Behavioural		

Figure 72.2 Comparing and contrasting two different habitats

Exercise 73
Sand dune plants

Method

1. When you get to the beach, collect a thermometer, compass and anerometer and complete the table in Figure 73.2
2. Use the poster or information from your local beach protection agency to identify the plant species on the dunes, being careful not to damage sensitive plants.

   If previous year groups have made a herbarium of pressed plants that have been laminated, use these to identify specimens as well.
3. Make a quick profile sketch of the dune in Figure 73.2.
4. Now assign a key diagram like the one shown in Figure 73.1 and mark in your profile where these plants occur.

Questions

1. Which plant is dominant:

   a. Nearest the sea?

   b Nearest the land?
2. Explain the relationship between size of plant and position on the profile?
3. Which is the best plant at holding the sand together?
4. Is there any evidence of beach erosion? Give reasons for your answer.
5. Is there any evidence of pollution? Give reasons for your answer.
6. Does the amount of organic matter change as you go inland?
7. Turn to your textbook page 335 and use the information on that page to complete Figure 73.3.

   Now write a short paragraph on how the dune system in your beach works.

Conservation hints

1. If at all possible study the dune system from a walkway (see Exercise 29 on how to build a walkway). Dunes are fragile ecosystems and damage to plants can cause the dune to blowout.

   Send one person in to take photographs of the dune system to reduce the damage and analyse the photographs back at school.

2. A permit may be required to collect plant species. If you collect, do so to make a herbarium record (see Pressing seaweeds Exercise 79).

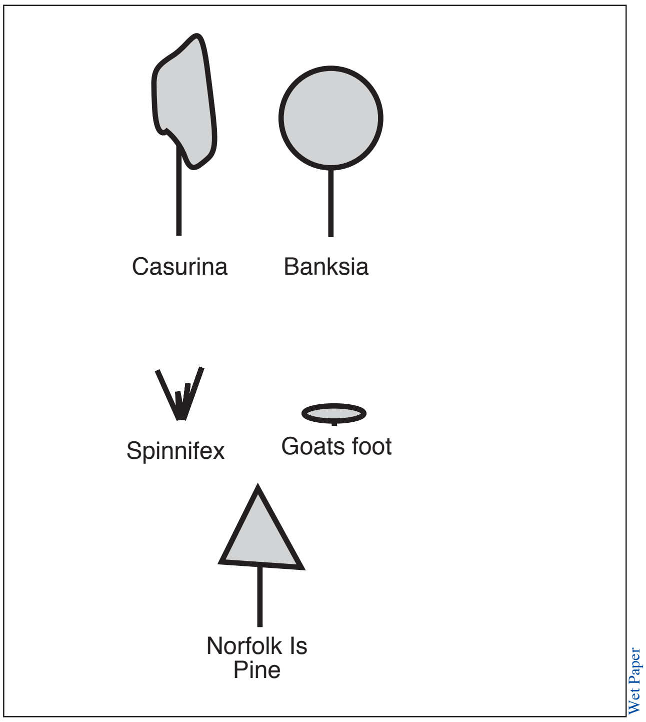


Figure 73.1 Dune key to plants

Materials and equipment (per group)

- a poster from your local Beach Protection Authority with photographs of local dune plants

  In Qld you can obtain one from the Department of Environment and Heritage, GPO Box 2595, Brisbane 4000
- table like the one opposite, drawn up from State Authority which makes dune plant posters

Weather report

Date and time of study

Tide

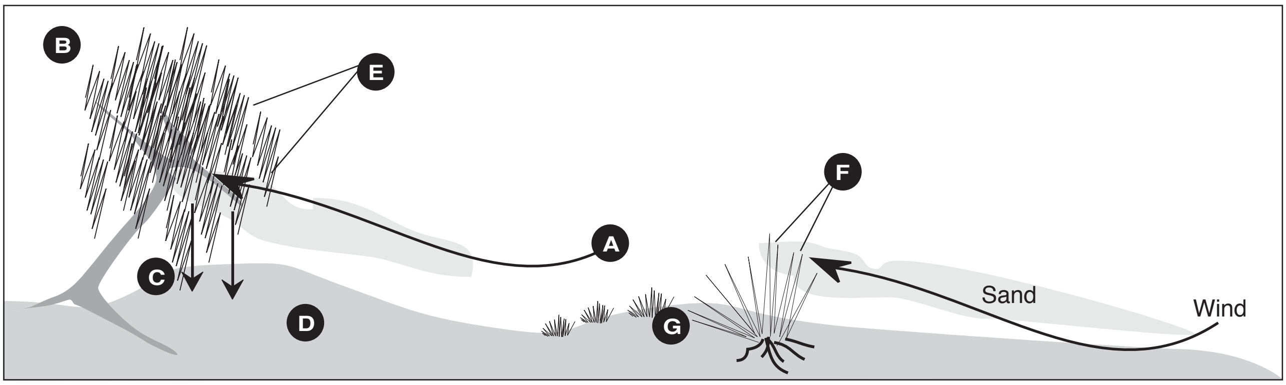
Wind speed and direction

Other observations

Temperature

Beach profile - rough sketch

Figure 73.2 Abiotic data and beach profile showing plant distribution



Matching letter	Statement
	Shape of secondary dune plant causes wind velocity to drop and sand falls to base of plant. Branches of plant fall and cover sand
	Secondary dune plant
	Sand falls
	Secondary dune
	Wind
	Shape of primary coloniser causes wind velocity to drop and sand falls to base of plant
	Primary dune

Figure 73.3 Do you understand how a beach system works?

Exercise 74
Prawn dissection

Based on an original exercise by Mick O'Connor and Bob Moffatt.

Method

Set up a tank containing live prawns, lobsters or crayfish so that you can observe the function of the parts of the prawn as you dissect it.

External anatomy

1. Take a mature specimen from the tank and place it into the petri dish. Using a dissecting microscope, note the regions of the body as outlined in Figure 74.1:
   a. head
   b. thorax
   c. abdomen

   Each segment has one pair of appendages and each region has a number of segments.
2. The Head
   a. There are six segments and five pairs of "cephalic" appendages in this region. The pairs of this region are heavily modified. The three pairs behind the mouth have been adapted as jaws while the two in front have been modified as sense organs.
   b. The 5th cephalic pair forms a large flattened plate called the "baler". It vibrates to produce a respiratory water current over the gills. Identify the "baler".
   c, The 4th pair are flattened bristled appendages used to manipulate food. Identify, then move onto the 3rd cephalic pair which form the jaw. Locate the mouth opening in between the two modified appendages.
   d. The remaining two pairs of appendages have been modified as sensory organs. The 2nd pair form the larger feelers. The first pair form a shorter sense organ which acts as a balance, auditory smell and chemical sensor. They also have a depression in which the eye ball can rest. A small eye brush occurs on their inner edges.
3. The Cephalothorax

   Locate the Cephalothorax, note the carapace which covers the head and thorax regions. These may be difficult to distinguish. There are eight segments in the thorax and five in the head region.
   a. Five of the eight thoracic appendage pairs can be readily seen. The 8th and 7th pairs have been modified for walking. The 6th, 5th and 4th pairs are used for walking, food capture and defence. They have small "nippers", called chela, on their extremities. Turn the prawn on its back, place the cephalothorax under the microscope and identify the origins of these appendages.
   b. Still with the prawn on its back under the microscope, using a blunt probe, find the 3rd pair of thoracic appendages. These are called maxillipeds and are used to hold the food while it is shredded and strained by the 2nd and 1st pair of thoracic appendages also called maxillipeds. Identify these.

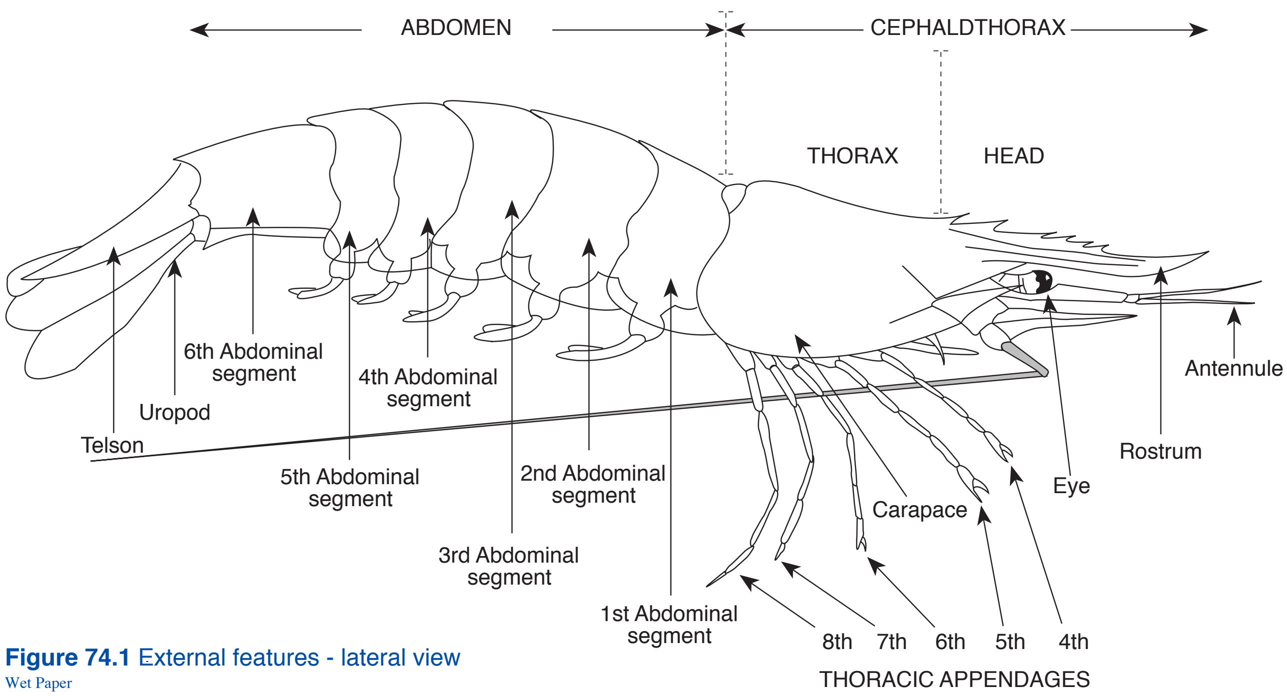


Figure 74.1 External features - lateral view
Wet Paper

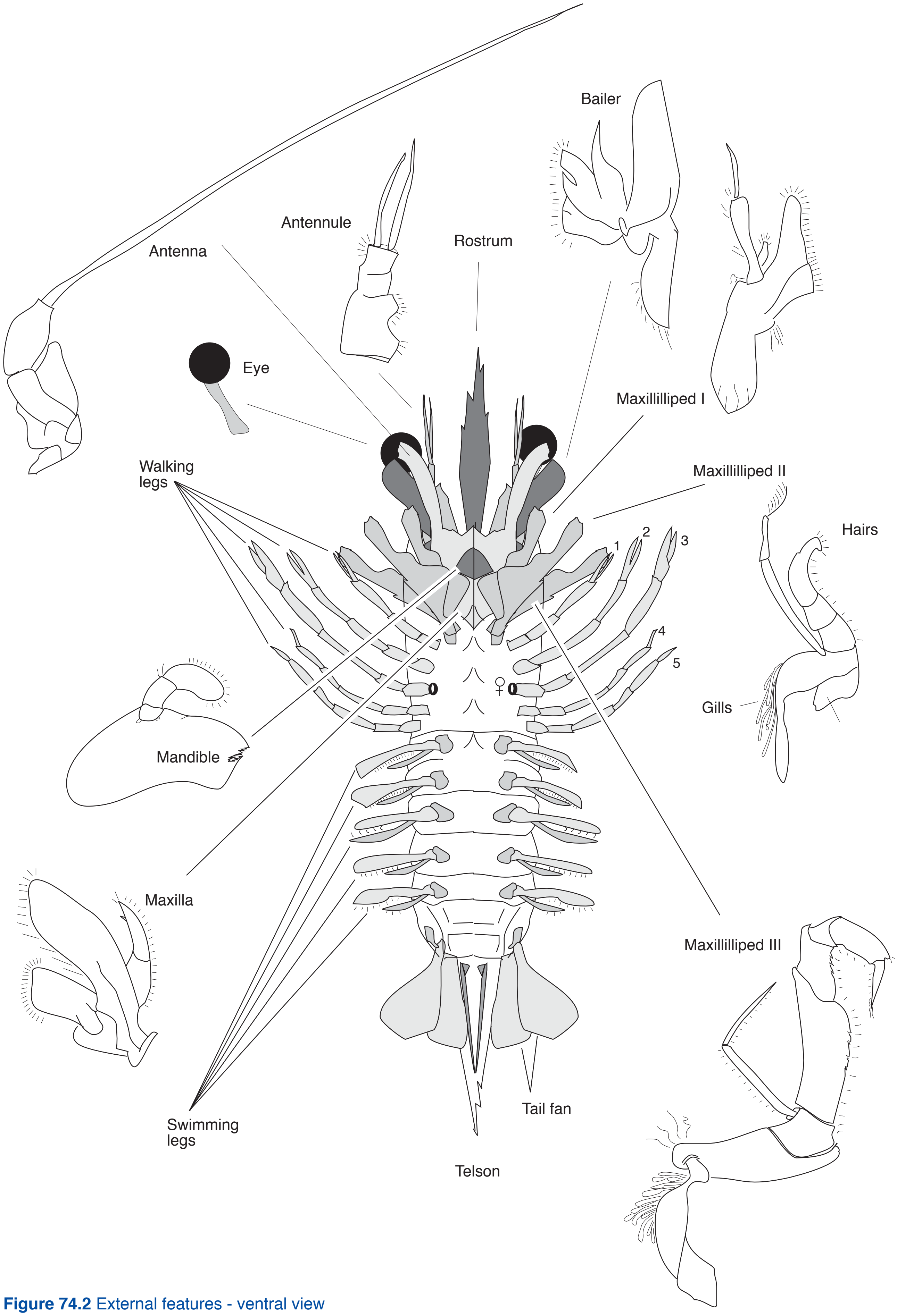


Figure 74.2 External features - ventral view

Wet Paper

4. The Abdomen

   a. Look at the abdominal region. There are six individual segments. The appendages of the 6th segment have been adapted for rapid backward propulsion. The "telson" and "uropods" form a paddle which, with the large flexor muscle (the edible prawn), provides an effective method of escape. Place a pencil near the rostrum of a sample in the tank, note the flattening of the uropods, the rapid flick of the tail and even more rapid backward propulsion.

   b. Using the dissecting microscope, look at the appendages of the 5th, 4th, 3rd and 2nd abdominal segments. They are flattened like small oars and have been adapted for swimming. Observe the prawns in the tank using the appendages for swimming.

   c. Study the first abdominal segment using the microscope. The appendages on this segment have been modified as sex organs.

   Locate the appendages and using Figures 74.1 and 74.2, determine the sex of your specimen. The female also has a thelycum.

Internal anatomy

1. The Respiratory System

   a. Lay the prawn on its left side in a small amount of water in a petri dish. Place it under the dissecting microscope.

   The gills are located on each side of the thoracic region and are covered by an extension of the carapace.

   b. Locate this region and observe the baler creating a current of water over the gills.

   c. Take a pair of fine pointed scissors, place one blade under the back lower edge of the carapace, lift up the carapace and cut away the section covering the gill region.

2. Removal of the Exoskeleton

   a. Hold the prawn with the dorsal side facing you then go to the rear of the carapace and with a sharp scalpel carefully cut down the dorsal mid line to the telson. Do this by placing the point of the scalpel under the first abdominal plate or terga and cut with shallow upward movements.

   b. Free the lower section and sides of the plates carefully with a scalpel. The chromatophores can be used as a depth guide here. The skin with the chromatophores should be left behind, i.e: the scalpel blade should be placed between the terga and the tissue containing the chromatophores.

   c. Remove all appendages (snip off at their origins with scissors). Remove containing carapace from right side of the cephalothorax by starting to cut forward from the rear dorsal end of the carapace, using the same technique as when cutting down the abdominal dorsal mid line. When the scalpel blade begins to cut, an air bubble will form between the exoskeleton and underlying tissue.

   d. Use the scissors to cut forward, freeing this section. If a air bubble does not form, continue cutting with the scalpel. Place the scalpel under the lower edge and lift off the remainder of the right side of the carapace.

   e. Now the whole right hand side of the prawn should be free of the exoskeleton and is ready for internal examination.

3. The Nervous System

   a. The main nerve cord is on the ventral side of the prawn and is easily recognised under the microscope by the ganglia along its length.

   b. Locate and note the ganglia.

   c. Locate and observe the antennules - these are the prawn's taste, smell, hearing and balancing organs.

4. The Circulatory System

   a. The prawn has an open circulatory system with a heart, blood and respiratory pigment. The blood is pale blue in colour due to the respiratory pigment hemocyanin.

   The heart lies under the dorsal rear section of the carapace. The heart pumps blood along the dorsal artery (aorta) shown in Figure 74.3.

   b. As the arteries branch, blood leaves the vessels and flows through the tissue to a system of ventral sinuses.

   The blood flows from the sinuses to the gills where it is oxygenated and then via blood vessels back to the heart. It enters the heart through a valved ostia.

   c. Locate the heart. Carefully, using a syringe, extract some blood and examine it under the microscope (high power).

   Identify the anterior and posterior aortas and trace as far as possible.

   d. To locate the ventral artery, take a fresh specimen and cut a transverse section through the thorax to the rear of the heart. Examine under the dissecting microscope, using Figure 74.3 as a guide.

5. The Digestive System

   a. Prawns eat small annelids and small molluscs. The mandibles have strong teeth which grind, tear and finally force food into the mouth.

   The food passes into the proventriculus where digestive juices are added. Digestion continues in the anterior section of the hind gut - absorption takes place along the remainder of the hind gut.

   b. From the mouth, using a scalpel and fine forceps, carefully remove overlying tissue from the

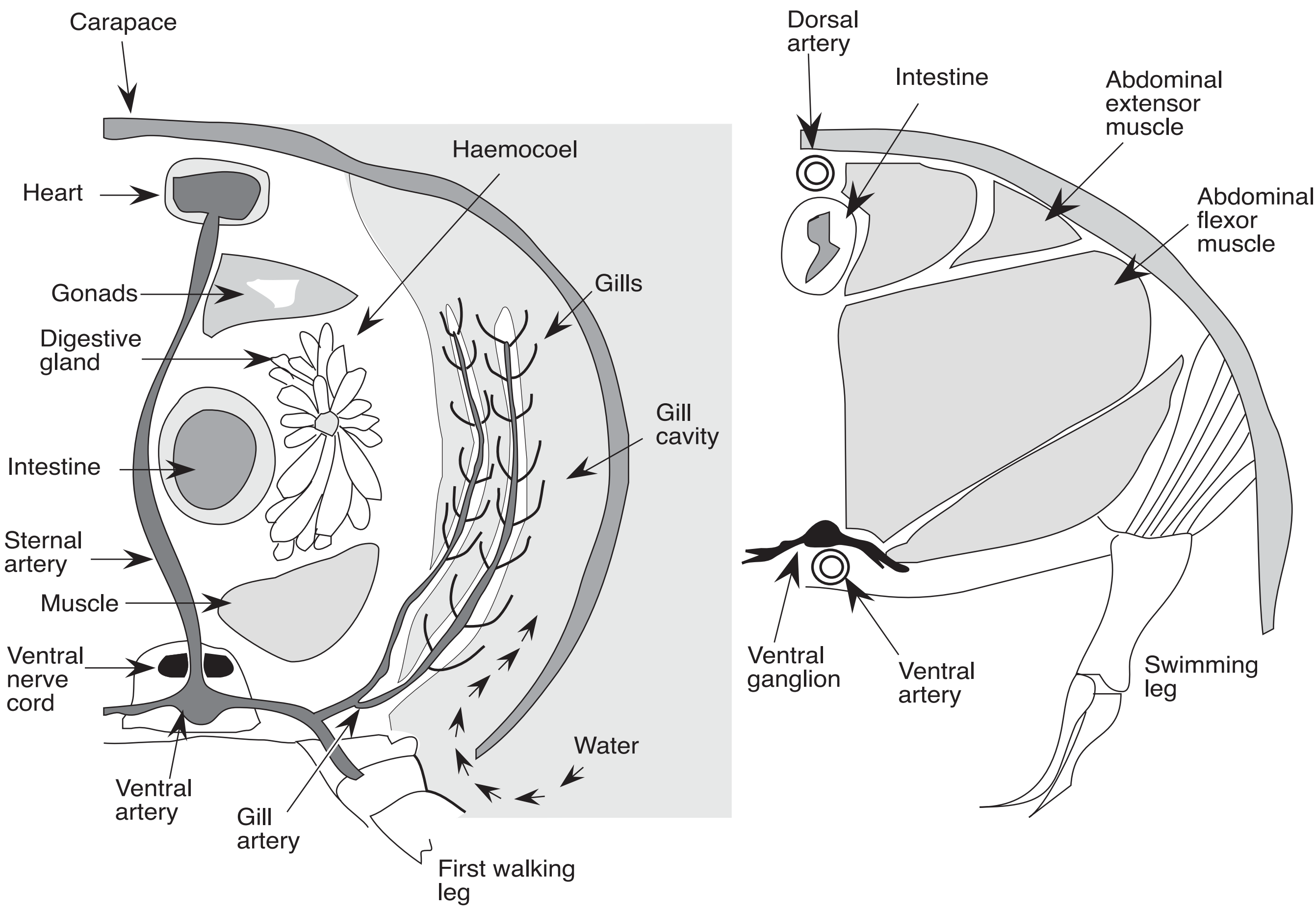


Figure 74.3 Internal features (the diagram on the left is a transverse section of the cephalothorax on the right is the abdomen. Hailstone 1968)
Wet Paper

oesophagus, remove the liver and expose the proventiculus and anterior section of the hind gut.

Trace the hind gut as far as possible and locate the anus.

6. Excretory System

   a. The prawn gets rid of its products of the metabolism using a structure called the green gland. These are the prawn's kidneys and are sometimes known as the antennal glands.

   b. These are two glands unidentifiable by their bladders, they are found in the head region and open into a pore at the base of the antennules.

   c. Locate the excretory pore of the right side green gland and carefully, using a scalpel and forceps, remove overlying tissue to expose the bladder.

7. Muscular System

   a. The muscular system is detailed and involved and beyond the scope of this study, however the huge flexor muscle of the abdomen is worth a look.

   b. Cut a cross section through the abdomen and identify the flexor and extensor muscles as shown in Figure 74.3..

Exercise 75
How to set up a marine aquarium

The purpose of this activity is to get an aquarium ready for the next two activities.

Method

The best place to collect your water is on an in-going tide, at the end of a boat ramp that is close to a clear body of water near to the sea so that you get maximum salinity (i.e. not in a river).

1. Rinse out each container with a sample of sea water and then fill to the top and screw on the cap.
2. You will need 5 x 2 L = 10 litres of water.
3. This sea water is usually full of anerobic and aerobic bacteria but when the water gets back to school, the closed environment of an aquarium will support only a small percentage of both bacteria.

   You need to allow sufficient time for the bacteria to establish their own new equilibrium by a process called conditioning.
4. Select a clean dust free area and fill each of the buckets with sea water.
5. Put the plastic bag over the top and secure it with string or elastic.
6. Arrange the buckets in the places you want your final aquaria to sit and cut tubing, valves to suit.
7. Cut the tubing to fit and connect the in-line valves as shown in Figure 75.1.
8. Connect an air-stone to the end of each line at one end and place through a hole in the plastic cover.
9. Connect the other end to the pump and switch on.
10. Adjust air flow to suit and use meters to measure salinity and/or water density.

Now your aquarium is ready for the next activities, when you will grow some small shrimp called Artemia from their eggs and study the effect of their growth on the quality of the water.

Safety

Boat ramps are slippery and often contain broken glass and sharp rocks. Wear proper footwear such a non-slip joggers.

Place the pump above the water line of the aquarium and bucket incase of power failure so that the water does not siphon back into the line.

If this occurs, water and power will mix with a chance of fire.

Wet Paper

Figure 75.1 **You may need to share aeration from a common pump**

MATERIALS AND EQUIPMENT (PER CLASS)

- 4 x 9 litre buckets
- containers to collect the sea water in (5 x 2 L PET soft drink bottles)
- transport to the sea
- towels or rags
- tide book
- suitable clothing
- pump
- air stone
- airline tubing
- in-line valves
- pair of scissors
- four aquariums
- 1 x TPS salinity meter
- aquarium hydrometer
- Glad wrap or plastic bag and piece of string or elastic to seal bucket

Notes

1. Make sure your aquarium is clean before adding the conditioned water.
2. Turn off the pump and disconnect air lines.
3. Take off plastic and remove air-stones and air line.
4. Tip the conditioned water into your aquarium and reconnect the air lines and air stone to the pump.
5. Your aquarium is ready for the living world.
6. Keep leftover water for adding to your aquarium.
7. Place the pump above the water line of the aquarium and bucket incase of power failure so that the water does not siphon back into the line.

Exercise 76
Food chains

Read Activity 75 before you do this exercise.

Method

1. Open the small glass cylinder or alfoil packet of brine shrimp eggs.
2. Use a tea spoon to collect a level amount of eggs and tip into the aquarium.
3. Take a sample of water and do a nitrite test according to the method on the test pack.

After 3-4 days

1. Make careful observations of the water in the tank.
2. Use a small beaker to collect a sample of shrimp and pout into a petri dish.

   Observe under a microscope.
3. Do a nitrite test a day after the eggs hatch and another after the water change.

   Record your data.

Materials and equipment (per group)

Equipment required

- small aquarium (from Exercise 75)
- small beaker
- more conditioned sea water in bucket
- towels or rags
- tea spoon
- brine shrimp eggs from aquarium shop or from:

  Australasian pet supplies
  Commercial Road
  Fortitude Valley Qld 4006
  Phone: 07 254 1222
- nitrite kit
- stero-microscope
- petri dish

Water change

This is necessary to introduce more bacteria to feed you shrimp.

1. Using an air line about a meter long, siphon from the bottom of the aquarium the refuse (egg shells and any dead shrimp).

   You will have to take out 1/4 of the height of the tank.
2. Now top up with leftover cured water, (make sure you have collected more sea water).
3. Do another nitrite test.

Questions

1. Define and give examples of each of these terms:
   a. producer
   b. consumer
   c. decomposer
   d. nutrient
2. Classify each of the following as producers, consumers, decomposers or nutrients:
   a. beach worm
   b. sea lettuce
   c. bacteria
   d. pippi
   e. nitrates
   f. prawn
   g. dinoflagellate
   h. fiddler crab
   g. algae
3. Explain Figure 76.2 in two paragraphs.
4. Construct a marine food chain similar to Figure 76.2. Select four components of the food chain from the following list.
   - beach worm
   - algae
   - larval of sea urchin
   - dolphin
   - sea shag
   - shark
5. What order of consumers are humans?
6. Invite an aquarist to class to talk about osmotic shocks.

Fig 76.1 Brine shrimp eggs and Artemia on 320 μm plankton net

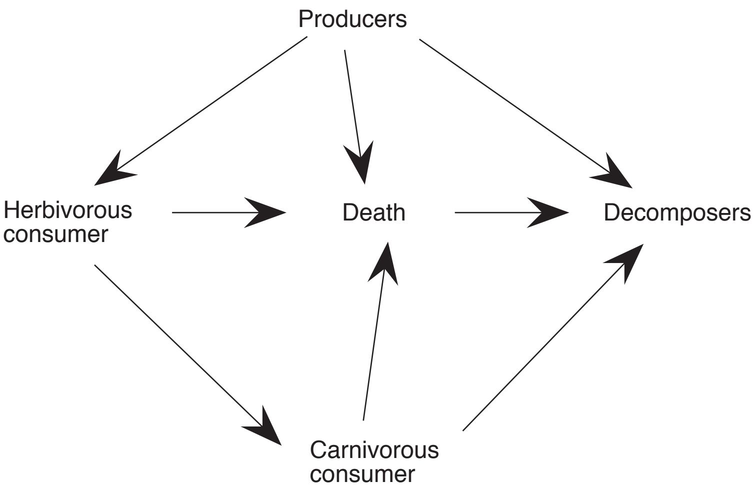


Fig 76.2 A food web
Wet Paper

EXERCISE 77
ARTEMIA LIFE CYCLE

Based on an original exercise by Alan Wolfe, South Fremantle High, with slide by Geoff Jensen and Bob Moffatt.

METHOD

Part A

1. Weigh 4 g of Artemia eggs and add to 200 mL seawater at 23 ^{o}C in a 400 mL beaker.
2. Place above in a water bath also at a temperature of 23 ^{o}C .
3. Use an aerator to bubble air to hydrate gently for 36 hours approximately 20 cm under an artificial light source at 23 ^{o}C to encapsulate the eggs.
4. After 36 hours, draw 3 to 5 mLs of sample into a 10 mL pipette and quickly release 1 mL onto a plankton net slide (see Figure 77.2).
5. Count the number of larval Artemia (including those partially hatched) per square cm with the plankton net slide and steromicroscope. Study Figure 77.1 to determine which stage the larvae are at.
6. Repeat steps 4 and 5 twice more to get an average count and record this in Figure 77.3.

   Note:

   Some artemia eggs require a different encapsulation process and this is usually described on the packet in which they came.

MATERIALS AND EQUIPMENT (PER CLASS)

- small aquarium (from Exercise 75)
- brine shrimp eggs (from Exercise 76)
- laboratory balance and watch glass
- artificial light source
- water bath
- 10 mL pipette
- filter paper
- Jensen counting side

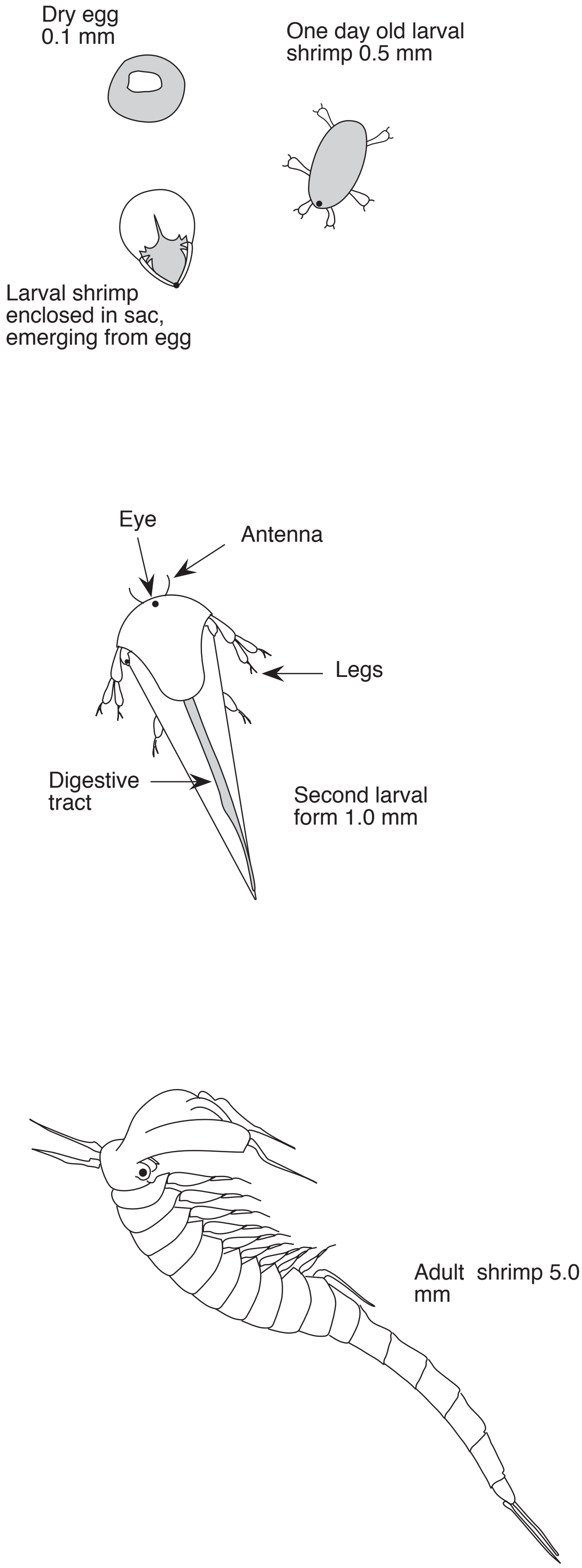
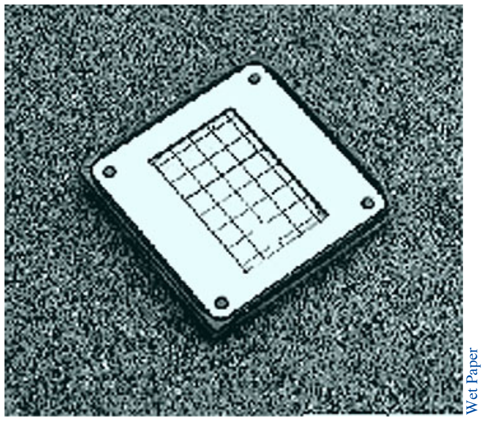


Figure 77.1 Artemia larval stages and adult (Wolfe 1995)
Wet Paper

Instructions on how to make a plankton net slide

1. Collect a plastic photo slide frame, a piece of 3 mm clear plastic sheet, one 200 µm square of plankton net, an overhead transparency sheet that has had .5 or 1cm squares copied onto it and tube of 5 minute Araldite glue.
2. Cut all sheets to size.
3. Glue together as shown in steps 1 - 4 below.
4. Try making other sized counting grids using 250 µ and 300 µ squares of plankton net offcuts.



Plankton net slide

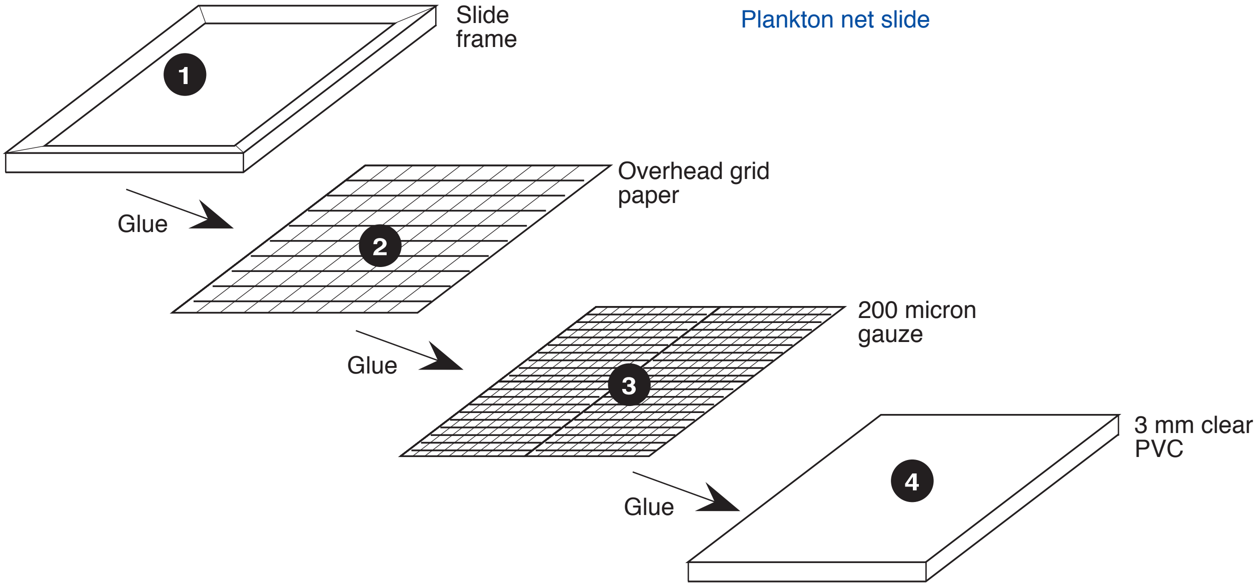


Figure 77.2 Geoff Jensens plankton net slide and construction details
Wet Paper

Artemia count / sq cm				
LIfe cycle stages	**Count 1**	**Count 2**	**Count 3**	**Average**
Eggs				
One day old larvae				
Second laval stages				
Adults				

Figure 77.3 Part A results
Wet Paper

Part B

1. Read the information in Figure 77.4.
2. Elect a class co-ordinator who is to divide the class into six mixed groups.
3. One of the groups is to be the control group while the other five are to select controlling factors from Figure 77.4.
4. Each group is to discuss and design a method to test their factor by modification of the standard procedure.
5. Write out your group's method in Figure 77.5 and add your results when they become available.
6. Combine your results into a class data table like the one shown in Figure 77.5.
7. Formulate and write a conclusion on all the factors that have been tested in the space provided in Figure 77.5.

Factors that affect the production of artemia:

1. Salinity. Normal seawater is 35 g/L but can rise in shallow pools that are heated or fall as freshwater dissolves from runoff from the land.
2. Temperature. Ambient temperature is about 23^{o}C however this can rise to as high as 30^{o}C or fall to as low as 8 ^{o}C in Australian waters.
3. pH. Seawater has a pH of about 8 but can be lowered by the addition of freshwater or acids from marine plants to pH 4. It can be raised by the addition of basic materials from shellfish or urban runoff to as high as 10.
4. Overcrowding. As the number of artemia increases in a given volume of water, competition for food, space and available oxygen can decrease the chance of survival. Is 4 g/ 200 mL an ideal population density?
5. Premature chemical removal of cysts. It has been shown that the following bleaching can effect population densities.
    a. Three hours after gentle hydration in part A (step 1), drain and then mix hydrated cysts with 50 mL of 4% bleach solution.
    b. Stir every 20 seconds for 15 minutes then rinse through a 200 micron sieve with fresh water.
    c. Add the decapsulated cysts to 200 mL of fresh sea water, return to water bath and follow part A (steps 3 - 6).

Figure 77.4 Factors affecting artemia

Group's method

Conclusions

Group

Class

Group's results

Factor	**Variations**	**Artemia count / sq cm**			
		Count 1	Count 2	Count 3	Average

Class results

Factor	**Variations with average artemia counts / sq cm**
Factor	

Figure 77.5 Group and class results. Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet.

Exercise 78
Fibreglass fish

Based on an original idea by Perry Kaigan, with photographs by Geoff Jensen.

Plaster work

Catch a fish of legal size. Alternatively go and buy a whole fish from the fish shop.

1. Wash the fish with sponge and detergent.
2. Rinse off detergent.
3. Wipe dry with cloth or paper towelling to remove all slime.
4. Place fish on side half buried in sand.
5. Fill mouth cavity with clay.
6. Place fins in realistic position.
7. Mix some plaster of Paris – enough to cover whole side and to overlap the sides by 2-3 cm.
8. Pour plaster over fish, gently quivering plaster into all parts.
9. Allow to dry.
10. Remove fish from mould as shown in Figure 78.1
11. If you like, you can now clean, fillet and cook your fish.

Fibreglassing.

1. Clean mould of any bits and pieces adhering — wash and let dry thoroughly.
2. Brush on a **thin** layer of release agent.
3. Using a brush, paint on a layer of resin.
4. Allow this layer to dry.
5. Mix more resin.
6. Brush on more resin and work in fibreglass matting — work in well to remove bubbles.
7. Allow to dry.
8. Remove from mould.
9. Trim and paint.

Safety

1. Caution: catalyst used in fibreglassing can cause blindness in 3 seconds if not washed out immediately with water, so wear safety goggles and use a well ventilated area such as under a tree or fume cupboard.
2. If you are in doubt ask your manual arts teachers who will be up to date with current workplace health and safety guidelines.

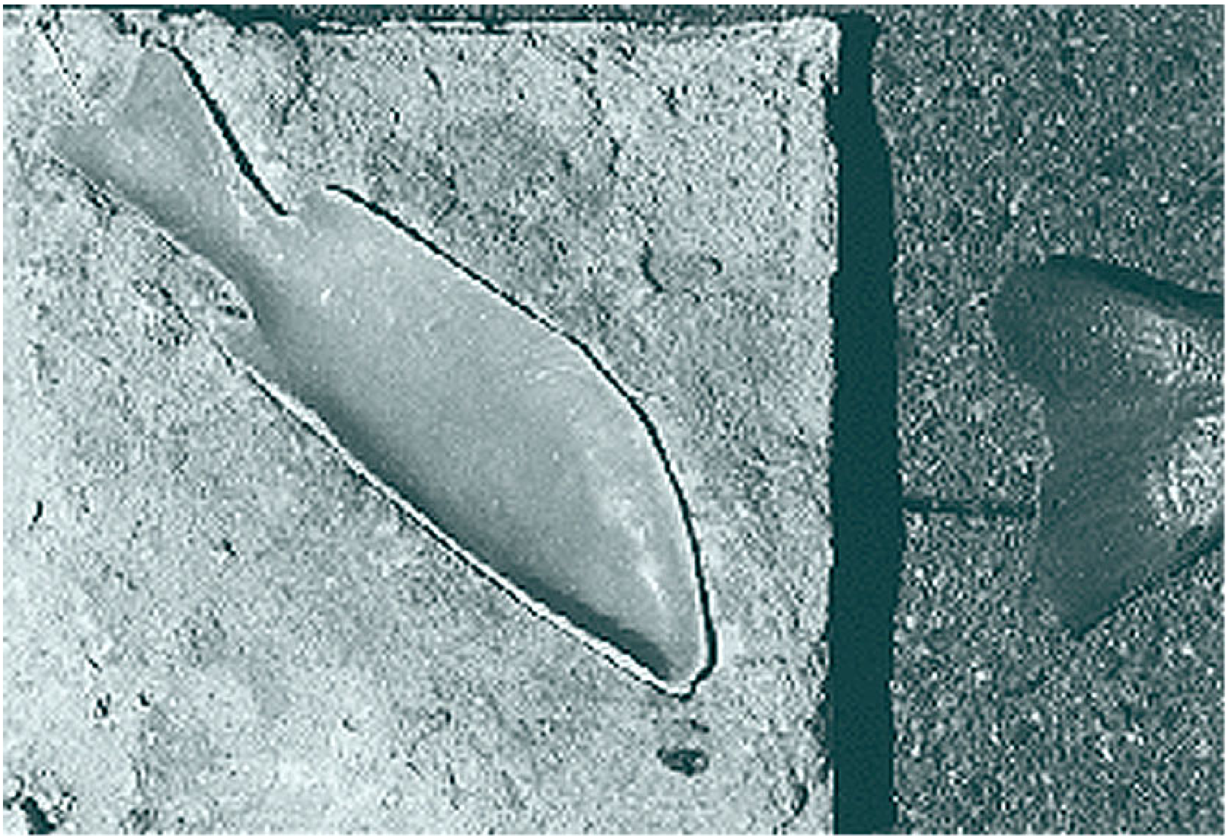


Figure 78.1 Mould made from plaster of Paris

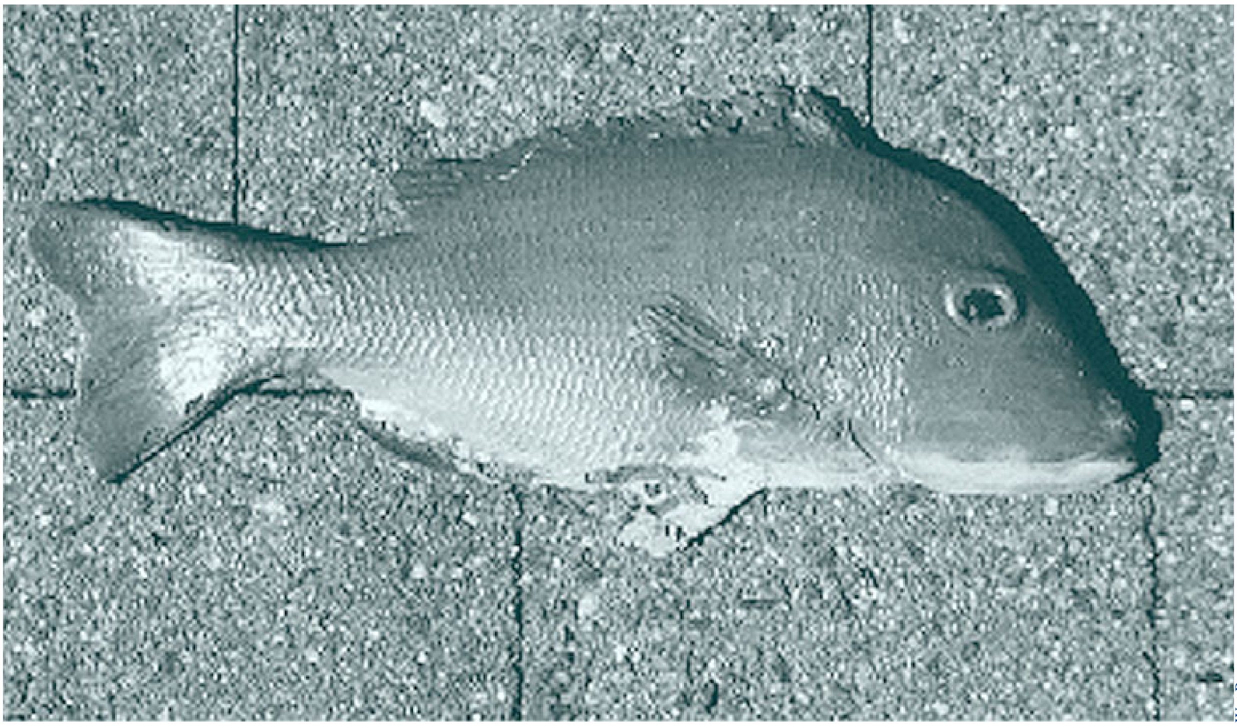


Figure 78.2 Finished fish

EXERCISE 79 PRESSING SEAWEEDS

FIELD METHODS

1. Collect seaweeds at low tide according to the safety suggestions in the box opposite.
2. Place all specimens in the same bag remembering that specimens are to fit onto a card with 8 cm left for information.
3. Number the bag and record information in your field note book detailing when and where you collected specimens (see Figure 79.1).
4. Notes:
   a. Try to collect living specimens. Dried, decaying or insect encrusted specimens are difficult to press.
   b. When removing the plant's holdfast, make sure this is carefully removed with the putty knife.

LABORATORY METHODS

1. Wash all specimens with fresh water to remove all mud and debris. If necessary trim the specimen to fit onto your card.
2. Use a plant key to identify the specimens. If you have difficulty, take a photo and send it off to your local herbarium for identification.
3. If the specimen is rounded, it can be teased out with a dissecting needle.
4. If the specimen is delicate, it may have to be ’floated out’. Place the algae in a shallow pan filled with water.
5. Float the specimen to a natural looking position and slip the card under the algae lifting the card slowly and carefully so the water will drain.
6. Place the specimen on blotting paper with a piece of waxed paper over. Do this for all the specimens in the following order:
   - cardboard
   - newspaper
   - blotter
   - waxed paper
   - specimen on card
   - blotter
   - newspaper
   - cardboard
7. After stacking all your specimens place them between two pieces of plywood and secure with straps. Note that algae require more pressure than botanical mounts.
8. Place near a fan so that air blows through the cardboard spaces. Change blotting paper each day.
9. Most plants will "glue themselves" to the cardboard. If they don't, use a small amount of superglue to fix.

Alternatives

You could try photocopying the algae onto a card or photographing the algae in the field.

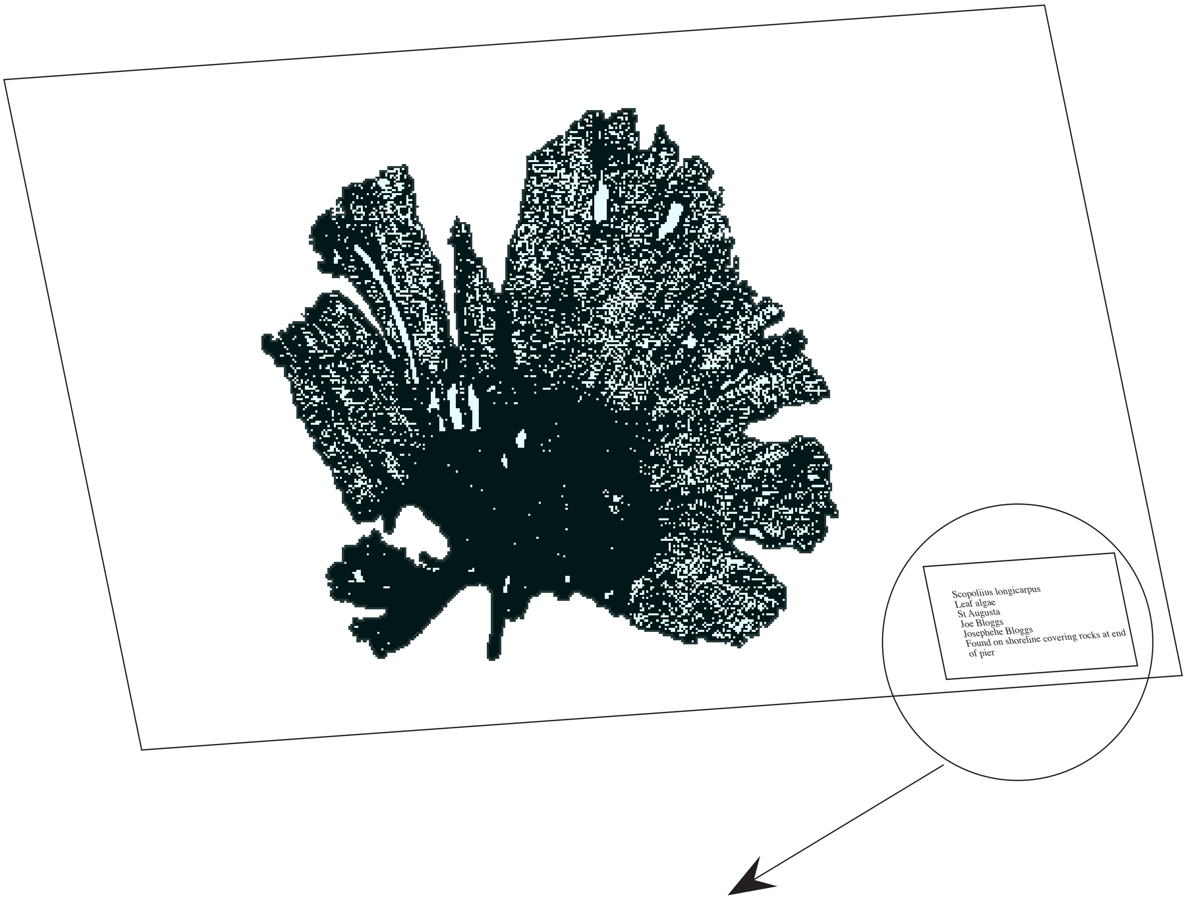
RESEARCH REPORT

1. Prepare a report under the following headings.
   - Aim
   - Method
   - Classification key
2. Comment on the value of a herbarium collection and the ethics of collecting marine specimens.
3. Comment on the value of the information recorded on the label of the seaweed specimen.

SAFETY AND CONSERVATION

1. Note in some Australian States a permit is required to collect marine specimens. Check with your local fisheries or conservation authority before collecting.
2. If you collect seaweeds on a rocky shore always wear shoes and gloves.
3. Never turn your back to the sea and don't go too close to where waves are breaking.
4. Look up the tide book before you go to make sure that you are collecting at low tide.
5. Collect only small amounts of seaweed according to your permit.

In Queensland you need a permit from the Department of Primary Industries.



Scientific name ______________________

Common name ______________________

Locality ______________________

Collector ______________________

Identified by ______________________

Remarks ______________________

____

____

Wet Paper

Figure 79.1 Sample record card

Materials and Equipment (per group)

- plastic bags and ties
- labels
- shallow pans or trays
- field note book
- wax paper
- newspapers
- cellophane wrap
- dissecting needle
- scissors
- putty knife
- 10 cm x 18 cm approx. cards or herbarium sheets
- plant press
- identification keys
- two pieces of plywood and straps to make a press
- camera (optional)
- superglue (optional)

Exercise 80

Turtles

Questions

1. On Figure 80.2, mark in the following features of the turtle life cycle as shown in your textbook Page 447.

    a. Coastal shallow water benthic feeding zones. Immature turtles ---> adult turtles.

    b. Development migration age at first breeding, about 50 years.

    c. Open ocean surface feeding zone, “the lost years”.

    d. Adult females, nesting beach, hatchlings, adult males, adult males and females, mating, eggs, two weekly intervals.

    e. Shallow water interesting habitat adjacent to nesting beach.

    f. Breeding migration at 2-8 year intervals.

2. Locate the section of hints for turtle watching and tagging and answer the following questions:

    a. What do you do if you find a turtle with a tag?

    b. Name three important things to do if you see a turtle coming up the beach at night.

    c. Make a copy of Figure 80.1 to describe how turtles lay eggs.

    Find out if temperature of incubation affects sex. Some say that turtles that hatch on one side of an island are one sex and those that hatch on the other are another. Is this true in your state? If so, why is this?

Class Presentation

1. Prepare a class talk on turtles and the need for their conservation and protection.

2. Write for a project booklet on turtles from:

    National Parks and Wildlife Office in your state or for a project sheet to the:

    Great Barrier Reef Marine Park Authority
    PO Box 1379
    Townsville, 4810

    Alternatively contact:

    Queensland Turtle Research
    NPWLS Pallarenda, Townsville, 4810

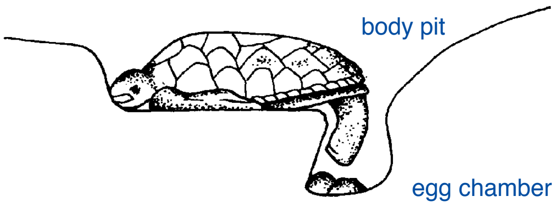


Fig 80.1 Turtle laying eggs
Wet Paper

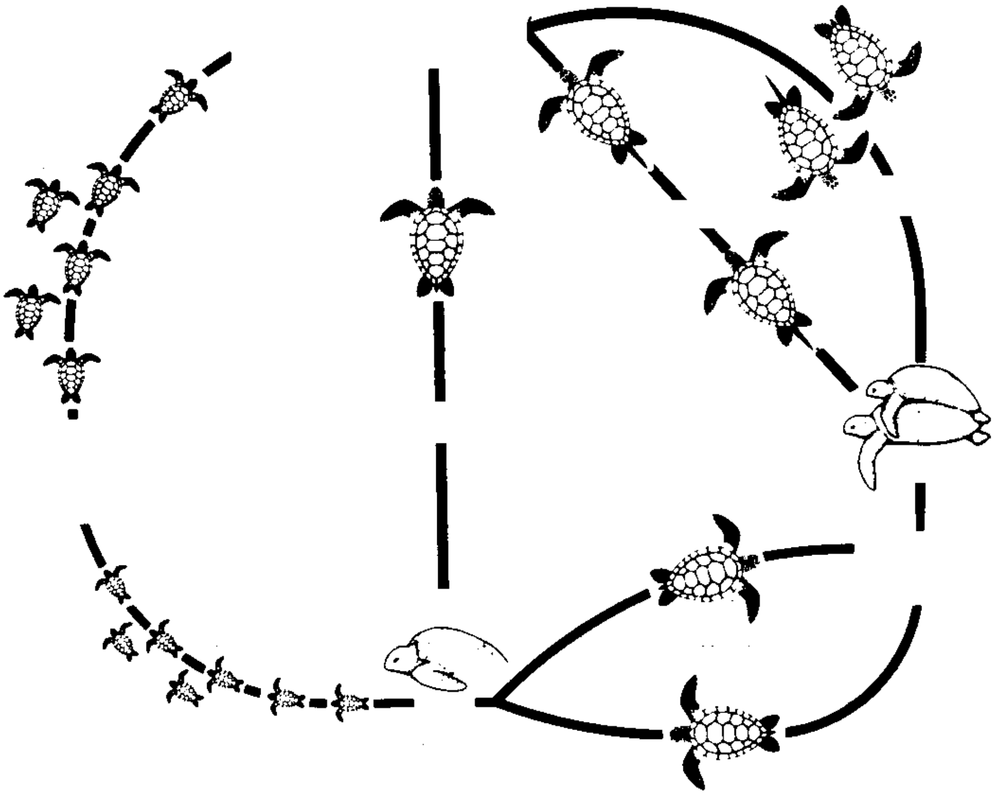


Fig 80.2 Turtle life cycle (Illustration from NPWLS Turtle brochure by Col Limpus)
Wet Paper

Exercise 81 Sea Birds

Questions

1. Turn to page 449 of your textbook to identify the following food sources for sea birds outlined in Figure 81.1:
   - sun
   - phytoplankton
   - zooplankton
   - large crustaceans
   - fish
   - mammals
   - birds
2. Now identify the following parts of the cormorants anatomy as shown in Figure 81.2
   - oesophagus
   - stomach
   - crop
   - intestine
3. Make a careful study of Figure 81.3. By using your textbook, mark which birds are involved in the following activities:
   - surface plunging- bomb diving
   - pursuit diving, and surface seizing
   - pursuit diving with wings
   - diving down and bottom feeding
   - chasing prey underwater
   - aerial pursuit
   - dipping
   - skimming
   - pattering
   - surface filtering and scavenging
4. Name three local seabirds in your area?

   What do they feed on and where are they found?

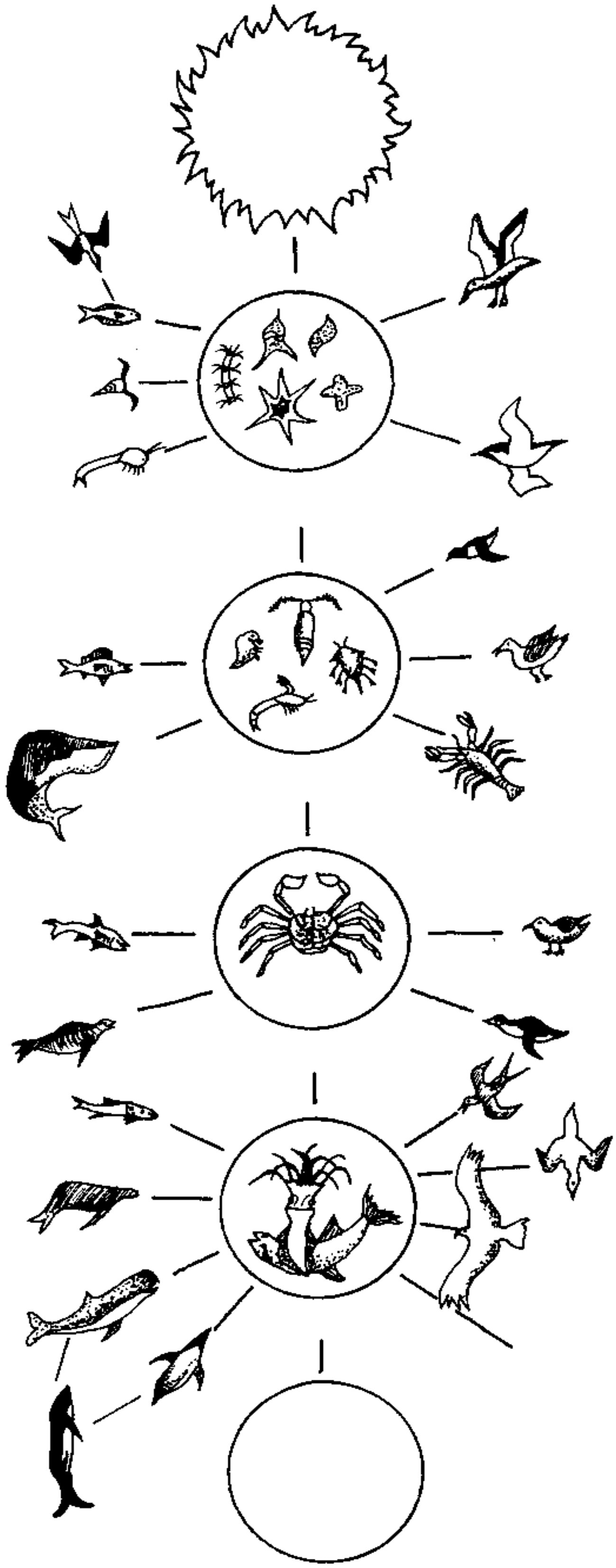


Figure 81.1 Food sources for sea birds as identified by Thurman and Webber (1984). Students may make one copy of this page so that they can attach their answers before handing in for marking.

Wet Paper

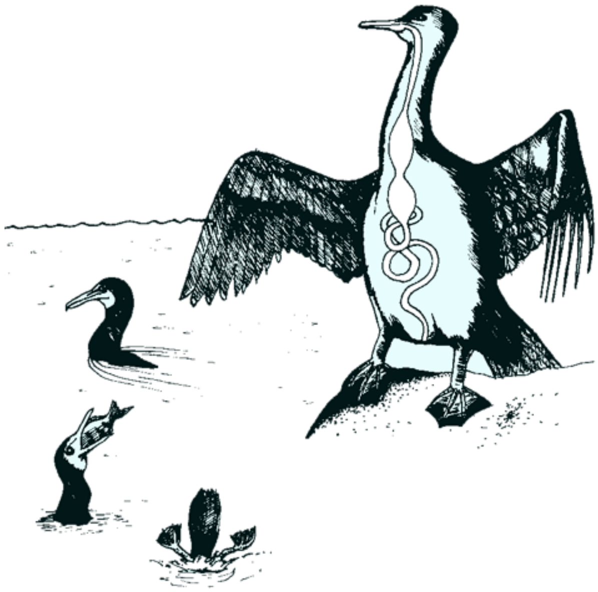


Figure 81.2 Cormorant feeding anatomy
Wet Paper

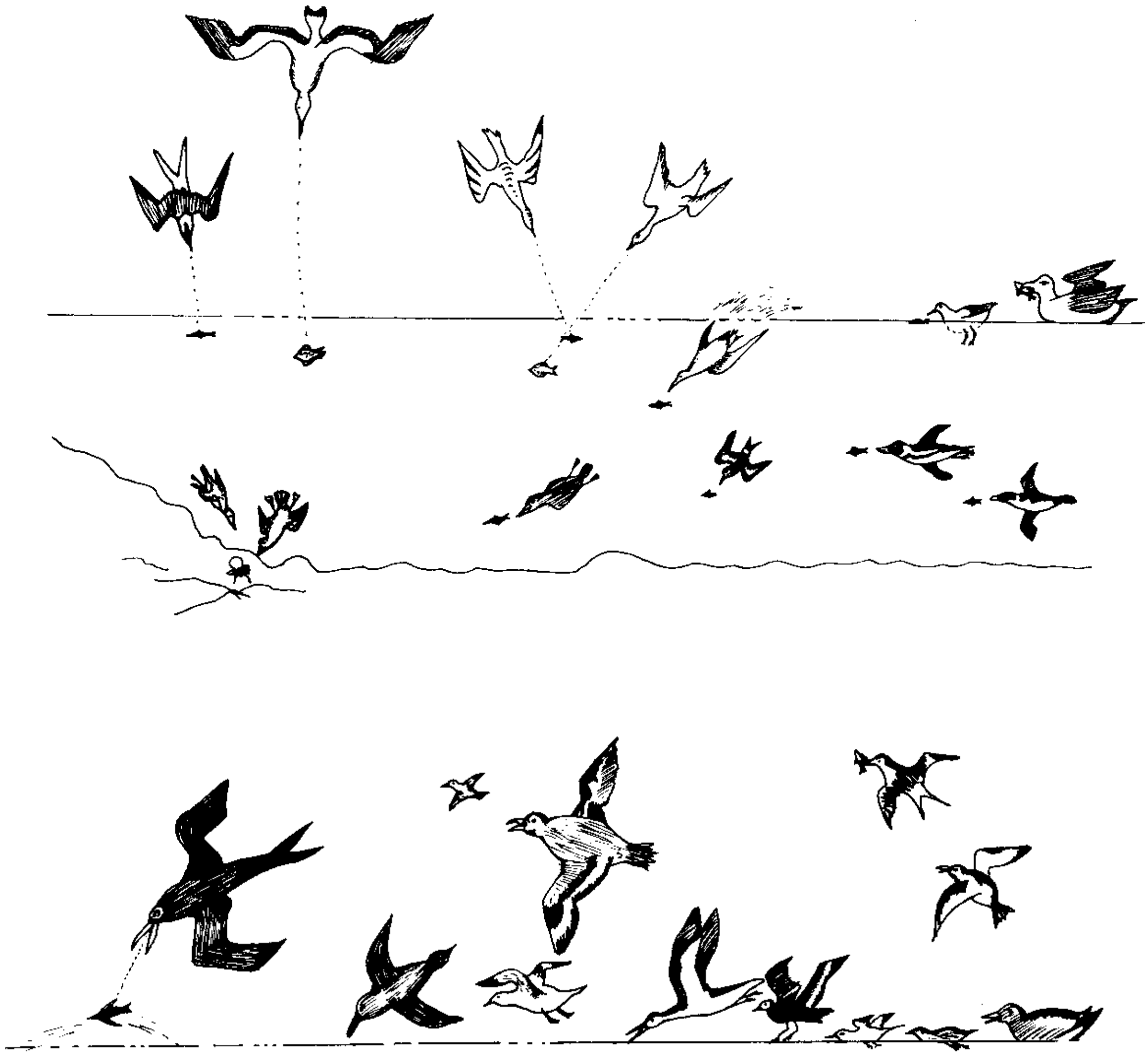


Figure 81.3 Feeding patterns - birds that feed on nekton (Aschmole, N.D. 1971. Sea bird ecology and the marine environment in Thurman and Webber (1984). Students may make one copy of this page so that they can attach their answers before handing in for marking.
Wet Paper

Exercise 82
Marine mammals

Questions

Use your textbook Pages 450 - 453 to answer the following questions:

1. What are the common names of the animals shown in Figure 82.1?
2. To which group of animals do they belong and what do they both have in common?
3. Mark on Figure 82.2 and 82.3 the following external features by referring to the schematic diagram in Figure 82.3:
   - blowhole
   - tail fluke
   - dorsal fin
   - pectoral fins
4. Use your textbook and local knowledge to draw in Figure 82.2 the migration patterns of Humpback and Southern Right Whales.
5. Describe one important difference in the way Humpbacks and Southern Right Whales feed.
6. Write to Sea World for a Project Neptune Kit to compare the behaviour patterns of Whales and Dolphins:

   Sea World
   PO Box 190
   Surfers Paradise Qld 4217

Whale watching excursion

1. Find out when your local whale watching migration is and investigate the range of Ecotourism packages available. South Australia has many such packages and an ecotourism package could be available from:

   Whale Centre
   PO Box 950 , Victor Harbour 5211
   Telephone (085) 525 644

2. Use the diagrams in Figure 83.3 and 82.4 to help you design a whale watching worksheet.

Dolphin watch

Visit the Bay of Islands in New Zealand and go on a snorkelling excursion with the Dolphins. Find out about whale watching excursions from Fullers Cruises in the Bay of Islands.

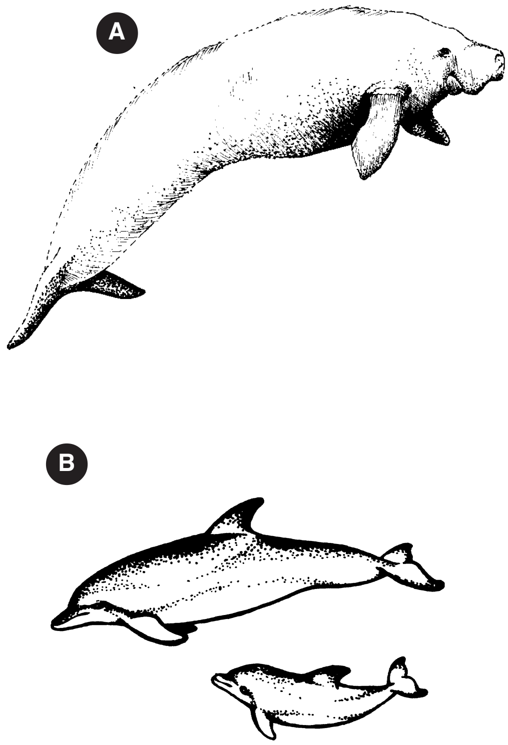


Figure 82.1 Some marine mammals. Illustration "B" is courtesy Sea World Project Neptune

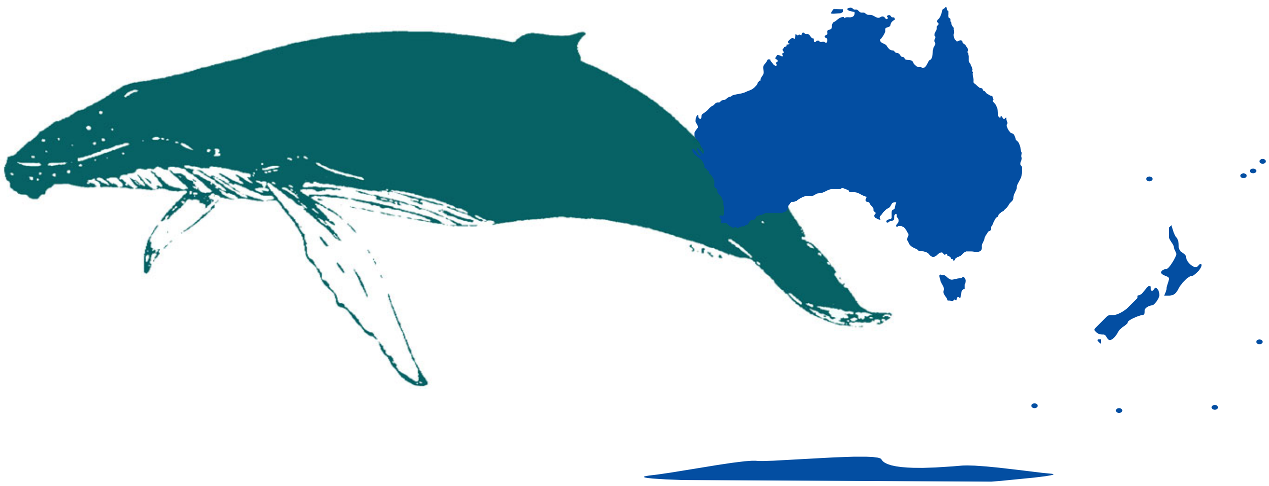


Figure 82.2 Humpback Whale (Steven Byers) and migration patterns

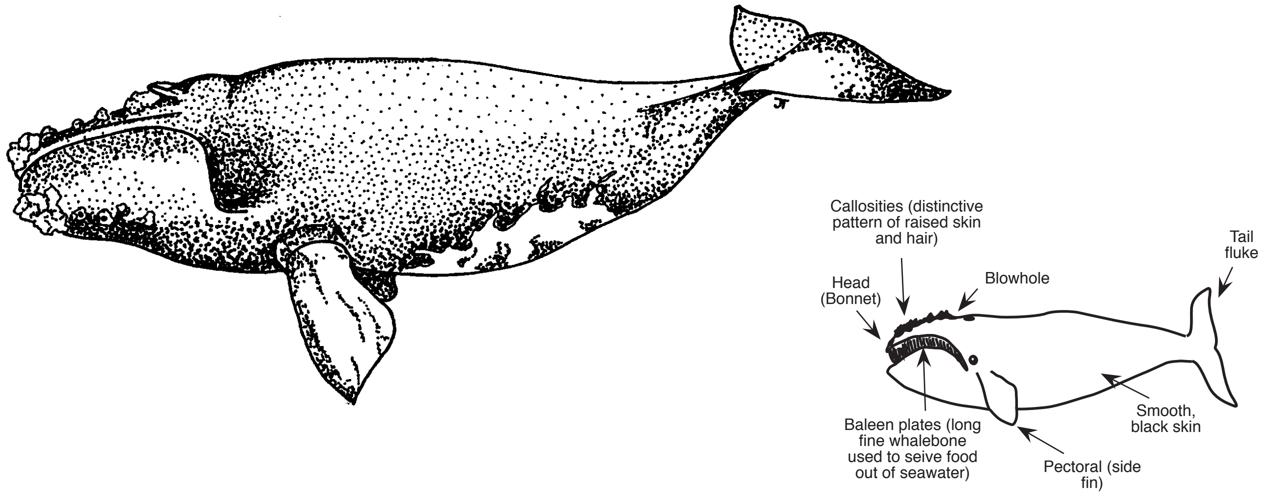


Figure 82.3 Southern Right Whale (Jan Thornton) and schematic diagram

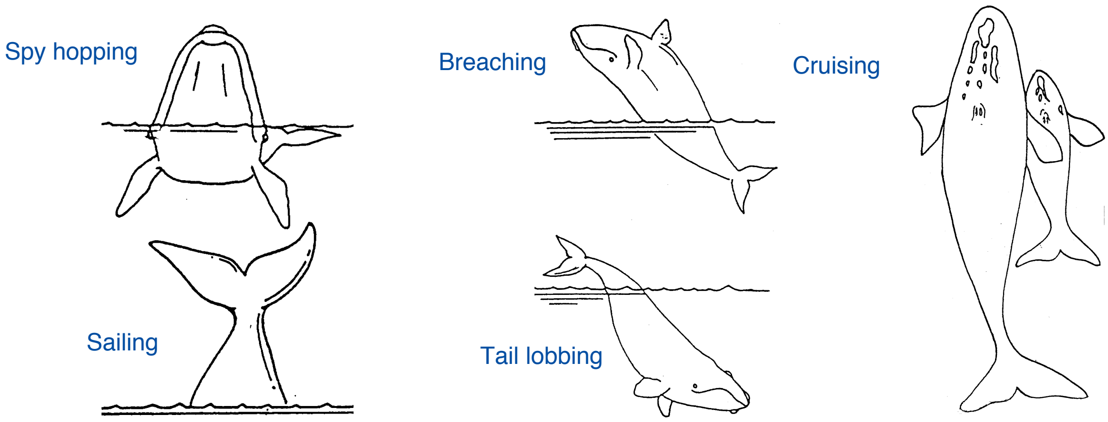


Figure 82.4 Southern Right Whale watching sheet (Illustrations courtesy SA Whale Watch Centre). Students may make one copy of this page so that they can attach their answers before handing in for marking.

Wet Paper

EXERCISE 83
CLASSIFICATION

QUESTIONS

Turn to Page 421 of your textbook and complete the tree of marine life as shown in Figure 83.1.

Now answer the following questions:

1. Name five benthic animals.
2. Are amoebas related to starfish? Give a reason for your answer.
3. Do scallops and squid belong to the same animals group? If so, what is the group's name?
4. What do Birds and sharks have in common?
5. The tree divides early into two very large distinct groups. What are these?
6. Why are bacteria and blue green algae not part of these groups?
7. Name three angiosperms, giving an example of each.
8. How many different types of worms are there?
9. Dugongs, whales, dolphins and seals belong to what animals group ?
10. What animals group does a crab belong to?
11. There are six kingdoms of individuals which inhabit the seas. What are they?
12. Name the subdivisions in the invertebrate group.
13. Name the subdivisions in the vertebrate group.
14. To what group does a copepod belong?

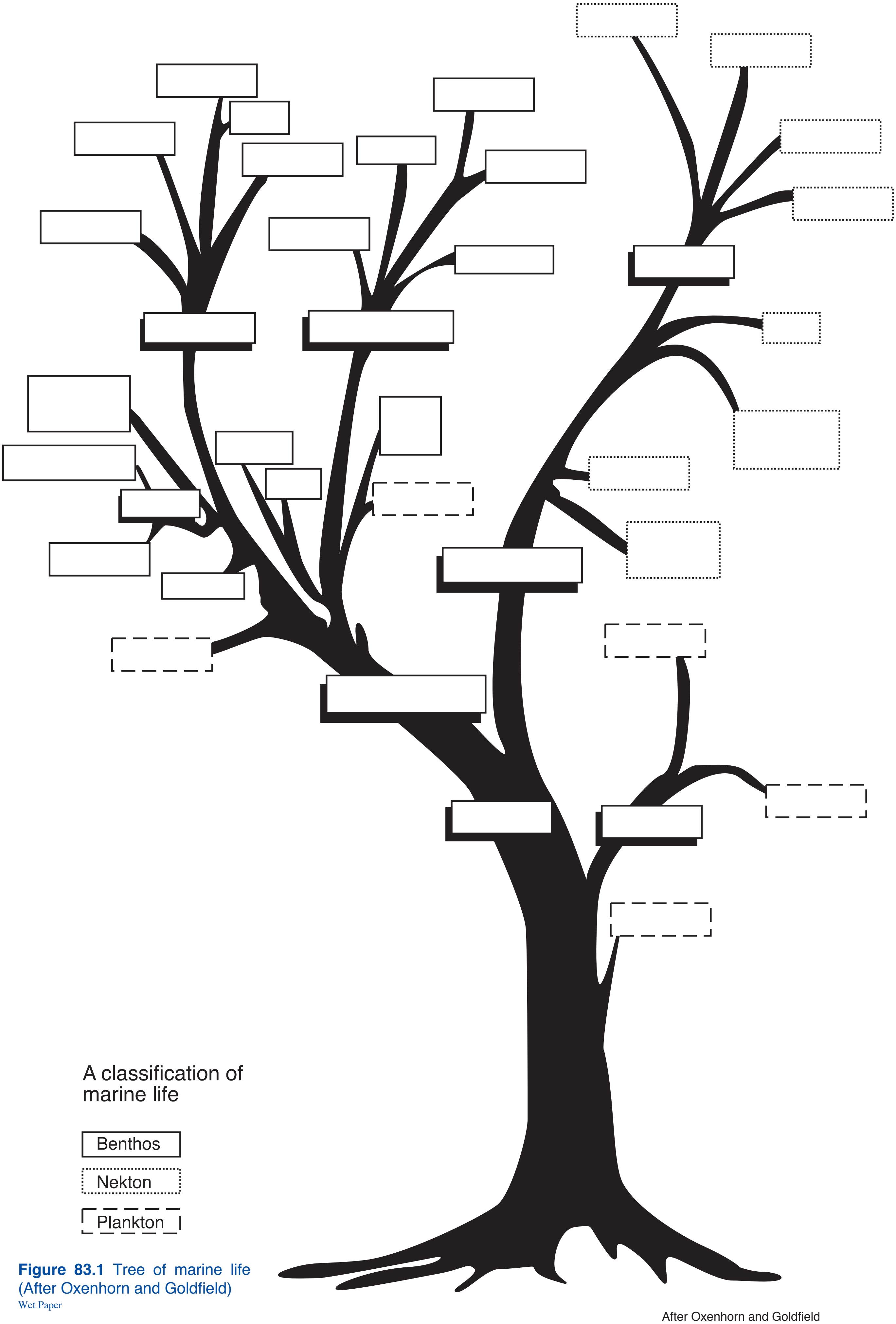


Figure 83.1 Tree of marine life (After Oxenhorn and Goldfield)
Wet Paper

Exercise 84
Classification Key

Based on an original activity by Tim Ryan, Maryborough State High School

Questions

1. Classify each of the fish in Figure 84.1 by using the key in Figure 84.2.

   To use the key, select a fish.

   Start at number 1a and read the statement. If it applies then go to the number allocated.

   Continue down the key until you reach the species name.

2. When you finish, write out the steps you used in the space provided under the key in Figure 84.2.

   Example:

   This fish has scales that are fairly large. The body is compressed, long and slender. The dorsal fin is single and situated near the caudal fin of the fish. This fish has very large eyes and large scales. The mouth is hinged in front of the eye. The mouth has a long slender beak. The upper jaw is much broader than it is long. It has a slightly forked tail.

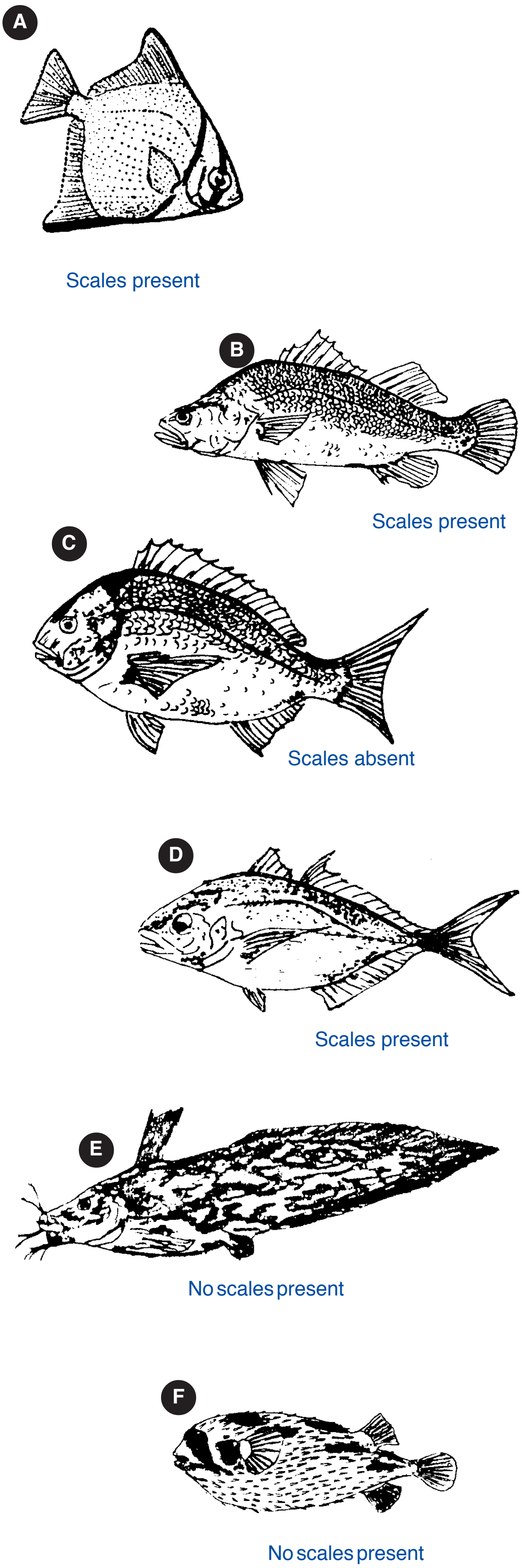


Figure 84.1 Fish to be classified
Wet Paper

CLASSIFICATION KEY FOR CERTAIN FISH

1a	Body more or less covered with scales	go to 2
1b	Body lacking scales or too small to be seen	go to 12
2a	Dorsal fins two or more, joined or separate	go to 3
2b	Dorsal fin single	go to 7
3a	Body long and narrow	go to 4
3b	Body less than 4 times as long as broad	go to 6
4a	Teeth large and sharp	Barracuda
4b	Teeth inconspicuous	go to 5
5a	Large eyes and large scales	Hardyhead
5b	Eyes normal and scale size	Sea mullet
6a	Dorsal fin joined	go to 7
6b	Dorsal fin separate	go to 8
7a	Dorsal and anal fins mirror image (similar in size and shape)	Diamond fish
7b	Dorsal fin covers greater length than anal fin	Bream
8a	Caudal fin rounded	Baramundi
8b	Caudal fin forked	Trevally
9a	Mouth small image in front eye	go to 10
9b	Mouth large hinge behind eye	go to 11
10a	Head has a pointed beak	Garfish
10b	No beak	Whiptail
11a	Eyes on opposite side of body	Wrasse
11b	Both eyes on one side	Sole
12a	body not elongated and snake like, dorsal, caudal and anal fins separate	go to 13
12b	Body elongated and snakelike	Pike eel
13a	Body long and narrow	Eel tail catfish
13b	Body less than 4 times as long as broad	Porcupine fish

SPECIES DESCRIPTION

A

B

C

D

E

F

Figure 84.2 Species key and description. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Wet Paper

Exercise 85
Seaweed
CLASSIFICATION

Questions

1. What are the scientific classification names for brown, red and green algae?
2. Make a copy of Figure 85.1 and use a pair of scissors to cut out each of the drawings.
3. Position each of the drawings on a piece of A4 paper and draw up a table around them using the following headings:
   a. description
   b. classification
   c. where found
   d. illustration
4. Use the information in the boxed section to help identify the plants.

Descriptions

Sea lettuce *(Ulva)*

This is common in bays, harbours, reefs and rocky shores and is the easiest to identify because it looks like a crumpled sheet of cellophane. It flourishes in areas where water has been contaminated by pollution. This is a green algae.

Intestine shaped algae *(Enteromorpha)*

This is a long plant with no branches in the stem. It has a small holdfast often not visible. *Enteromorpha* is commonly found in whaves, buoys, woodwork and on boat hulls and has a high tolerance to fresh water. *Enteromorpha* is a green algae.

Bull kelp *(Nerocystis)*

Bull kelp is found in large beds in cold water and has a very long stipe with many long blades growing from a central air bladder. Bulk kelp forests provide the home for sea otters.

Bladder kelp *(Macrocystis)*

This also forms large kelp beds but has a series of "leaf like" structures growing from a number of stipes growing from a central holdfast. These kelp beds provide the home for many animals where undersea forests can grow at up to 30 cm a day. The plants can grow to a depth of 30 metres and are harvested in some countries of the world.

Oar weed *(Lamanaria)*

Oarweed has a single, unbranched stipe with a plain single blade and is a brown algae. These plants are large and may reach half a metre in width. They are often found in shallow waters. *Lamanaria* was famous in the past because it was burnt to make soda ash. Another use was for the production of iodine and as a source for algin, used in ice cream.

Rockweed *(Fucus)*

This is small, brown plant with mainly branching blades. It grows in exposed areas around the high tide mark. This is a brown algae.

Turkish towel *(Gigartina)*

This a large broad based algae found in the intertidal zone. This is a red algae.

Blade algae *(Iridaea)*

This is shaped like a leaf with a series of serrations along the margin. A red algae, this is found on rocky shores.

Coralline algae *(Corollina)*

Coralline algae have become impregnated with calcium and are found in beadlike threads. This is a small thin branched plant belonging to the red algae family.

Figure 85.1 Common algae. Students may make one copy of this page so that they can cut it up and place in their table before handing in for marking.

Wet Paper

Exercise 86 Underwater SLATE

By Geoff Jensen, Innisfail SHS.

Method

1. Take six metres of sewerage pipe that is 10 cm internal diameter and 3 mm thick and cut into 20 cm lengths as shown in Figure 86.1.
2. Make a saw cut on one side.
3. Heat over a flame until the PVC starts to soften and then gradually flatten.
4. When the PVC is almost flat, place into an oven at about 150 °C between compressing weights to make a perfectly flat surface that does not require any further treatment.

   A good idea is to do this in the manual arts section of your school that has an oven with a glass front. Under the guidance of your manual arts teacher you then watch as the PVC flatterns.
5. To finish, drill a hole at one end and attach a piece of cord and then at the other use a piece of rubber tubing to hold the pencil.

Materials and Equipment

- friendly manual arts teacher
- 30 metres sewerage pipe 30 mm internal diameter and 3 mm thick
- saw
- oven
- flame
- drill
- pencil and rubber tubing

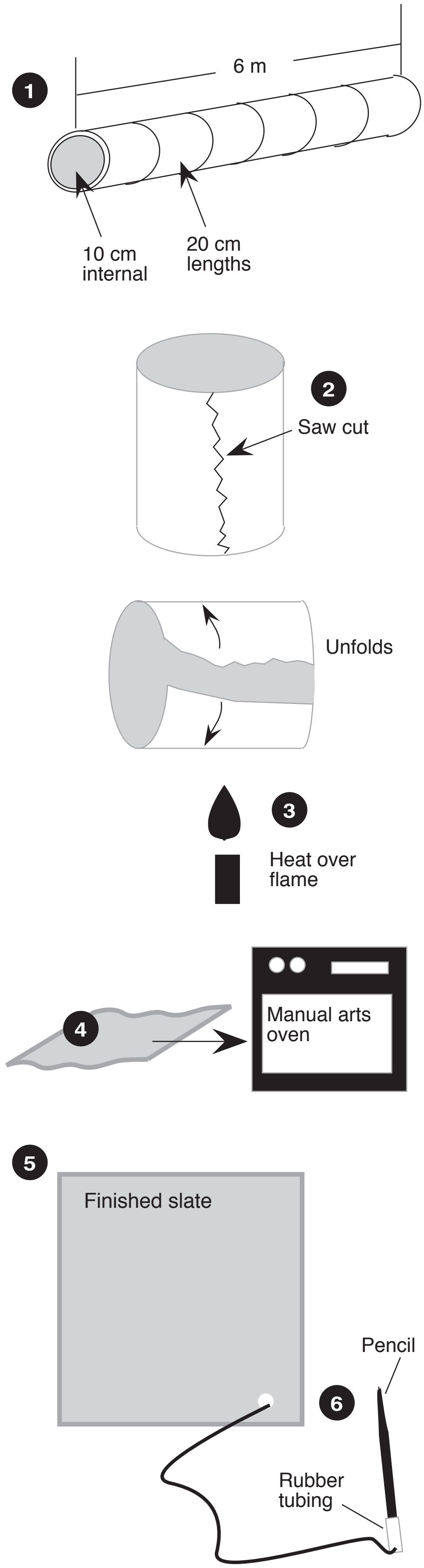


Figure 86.1 Underwater slate mass production
Wet Paper

Exercise 87
Nekton test

Diagnostic Test

Knowledge and understanding

Time 30 minutes

1. The group of animals that swim freely in the sea from top to bottom are called:
   a. Benthos
   b. Fish
   c. Nekton
   d. Streamlined organisms

2. In order for water to enter cells, it has to pass through a cell membrane. The mechanism which regulates this is called:
   a. Osmosis
   b. Diffusion
   d. Semipermeable membrane
   d. Excretion

3. A fresh water organism normally:
   a. Takes in more water to flush its system
   b. Has a steady water loss by osmosis
   c. Actively absorbs salts via the gill
   d. Produces little urine

4. Which of the following are most closely related?
   a. Fish and whales
   b. Scallops and octopuses
   c. Turtles and dolphins
   d. Fish and sea snakes

5. Which of the following statements about sharks and rays is FALSE?
   a. Sharks and rays are not true fish
   b. Sharks and rays have their mouth and gills on the ventral surface
   c. Sharks lack air bladders
   d. Sharks and rays reproduce by internal fertilisation

6. The inner surface of the shark's organ of smell, called the olfactory pit, has many thin folds called:
   a. Lamellate
   b. Placoidal folds
   c. Myomere
   d. Opercullum

7. A shark's teeth are:
   a. Focused on the ventral surface
   b. Modified scales called placoid scales
   c. Not replaced when broken off
   d. Found in two lines across the mouth

8. The fin used to give the fish power through the water is called the:
   a. Dorsal fin
   b. Pectoral fin
   c. Anal fin
   d. Caudal fin

9. Ctenoid scales are found on:
   a. Most bony fish
   b. Sole fish
   c. Gar fish
   d. Sharks and rays

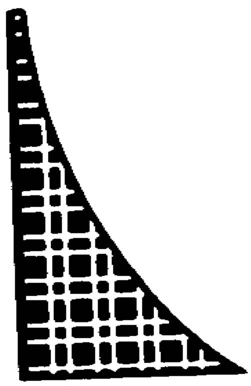
10. Which of the following statements concerning fish is FALSE?
    a. Blood is circulated by a two chambered heart
    b. The swim bladder aids in breathing
    c. A fish's age can be determined by the study of its scales
    d. All fish are carnivorous

11. Some fish live part of their lives in fresh water and part in salt water e.g. salmon. These fish are called:
    a. Andromous
    b. Osmotic fish
    c. Lamellarie Fish
    d. Myomerie fish

12. Commercial trawlers often use otter boards with their nets. The otter boards:
    a. Spread the net apart
    b. Allow the cod end on the net to sink
    c. Float on the surface to attract pelagic fish
    d. Help to stabilise the boat

13. Demersal fishing requires:
    a. The use of deep nets on lines
    b. The floats to collect pelagic fish
    c. Danish seine nets
    d. Long sets of floats and lines

14. A fibreglass rod made from cloth cut as shown below would have:
    a. Soft action
    b. Medium action
    c. Fast taper
    d. Slow taper



15. A jig is:

a. A lure used in a vertical direction

b. A lure in the shape of a fish

c. A lure which disturbs the surface to catch predatory fish

d. A metal lure

16. Which of the following is a species of the Baleen whale:

a. Sperm whale

b. Humpback Whale

c. Killer whale

d. Dolphin

17. The filtering mechanism of Baleen Whales consists of a series of plates that hang down from the gum region of the upper jaw. These plates are:

a. Similar to teeth

b. Made of keratin as is hair in humans

c. Solid

d. All of the above

18. Which of the following statements about dolphins is false:

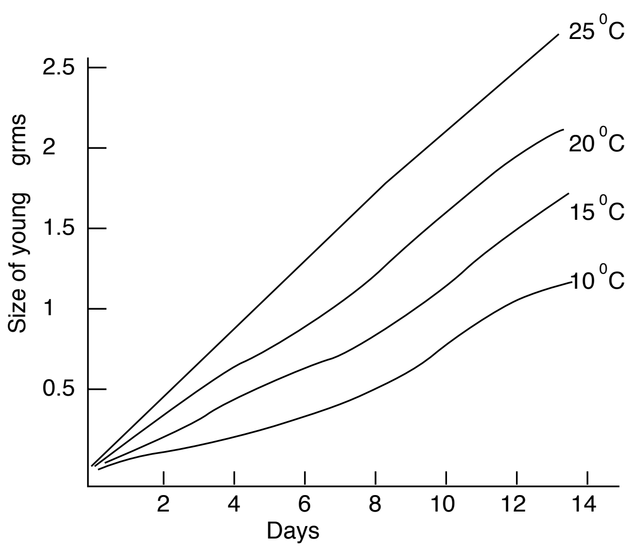
a. During a dive the dolphin pumps more blood to the brain and heart

b. Before a dive the dolphin exhales, thus causing the aveoli in the lungs to collapse

c. Dolphin's blood has a higher concentration of red blood cells

d. The dolphins tongue prevents water trapped in the blow hole from entering the lungs

The following information was collected by students investigating the conditions that best suit the development of fish eggs



Wet Paper

Use the following key to select the correct comment (A,B,C or D) to statements 19 and 20.

A. The statement is a reasonable conclusion

B. The statement is false according to the graph

C. There is insufficient evidence to establish this fact

D. The statement is not a conclusion but a restatement of results

19. Temperatures above 25 degrees centigrade are lethal to the development of fish eggs:

a. Alternative A

b. Alternative B

c. Alternative C

d. Alternative D

20. As the temperatures increase from 10 degrees to 25 degrees centigrade there is an increase in the development of the fish:

a. Alternative A

b. Alternative B

c. Alternative C

d. Alternative D

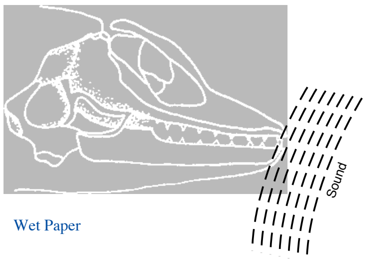
Answers

1. c	10. d
2. a	11. a
3. c	12. a
4. b	13. a
5. b	14. a
6. a	15. a
7. b	16. b
8. d	17. b
9. a	18. a

Information processing and reasoning

1. There is the constant problem of sinking for Nekton organisms. Discuss four methods nektonic organisms use to overcome this problem.

2. Use the illustration of the dolphin skull below to show how a dolphin echolocates.



Wet Paper

3. The following question refers to management of fish resources.

   If there is to be fish for people of the future to eat, then Australians will have to manage carefully our fish stocks. At present licences are issued to commercial fishermen. Fishing seasons are implemented and the type of net and gear are controlled. However, much of the damage is done by humans with the wrong attitudes. For example, some fishing trips to the reef involve those who return with ice boxes full of fish that they sell off to pay for their trip. If unrestricted fishing practices continue, then fish stocks will be depleted rapidly. Fish management authorities and marine parks rangers in general attempt at all times to change the attitudes of these types of people.

   Today the management of fisheries is gradually shifting to a centrally controlled piece of legislation that allows multi use of an area to a level that is called sustainable use.

   Debate the effectiveness of any two of the methods used below to manage fish stocks listing three arguments for and three against the statement.

   a. Whales, dolphins and all other mammals, birds and marine reptiles are totally protected in nearly all Australian waters.

   b. Mangroves and other marine plant species that act as basic food or nursery areas for fish are totally protected. Sea grasses are important sources of food for turtles and dugongs and reduction in the food available is almost as good as killing the adults.

   c. Seasonal closures, seasonal licences, provisions of artificial habitats, stocking and reviews of fish quotas are revised on a regular basis.

   d. Management measures involve control over the number of licences, size of nets and boats.

   e. Legal sizes, sex and numbers of fish caught are controlled. In all cases female egg carrying adult species are protected.

   f. Net mesh sizes - these set the minimum sizes of fish that can be caught for a certain area.

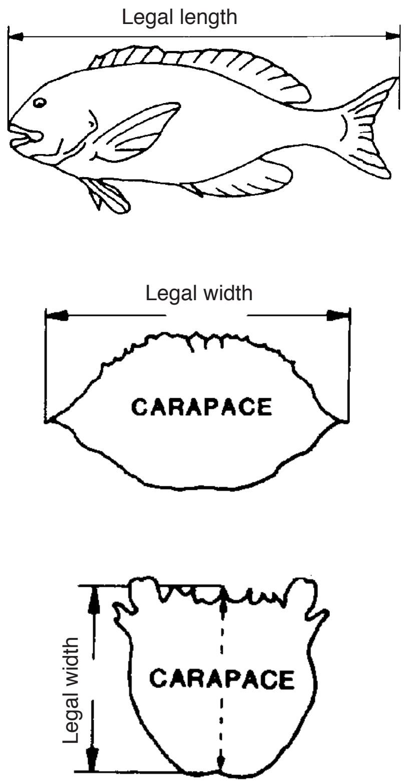
   g. Bag sizes - such as number of crab pots, number of fish that can be caught at any one time by an individual, number of hooks on a line.

   h. Licences - commercial fisherman licences to catch certain types and number of species in set times of the year.

   i. Protected species for a local area.

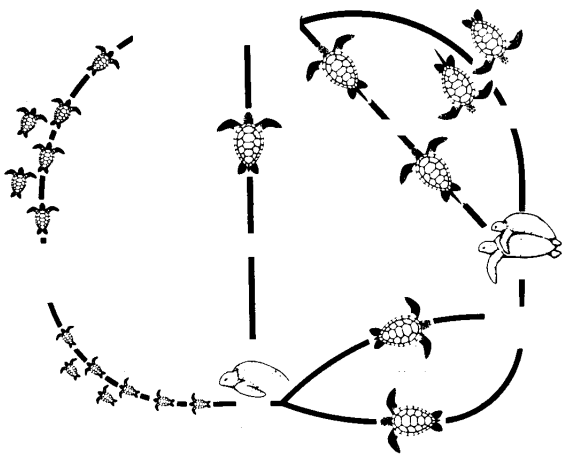
   j. Fisheries officers to enforce the law.

4. What is the significance of the illustrations below?



Wet Paper

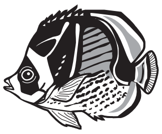
5. Use the diagram below to illustrate why we know so little about turtles



Wet Paper

Exercise 88
Benthos test

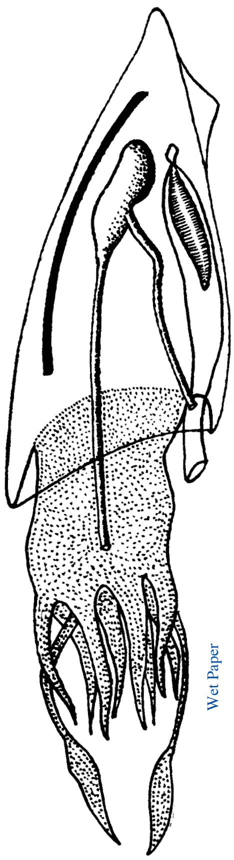
Knowledge and understanding



Time 30 minutes

1. Organisms that live on the floor of the sea are called:
    a. Benthos
    b. Nekton
    c. Plankton
    d. Sessile organisms
2. Which of the following statements concerning seaweed adaptations to life on the seafloor is FALSE?
    a. They have a holdfast to prevent them being washed away
    b. They have a short, thick shape to stop them being covered by mud
    c. They have specialised floating cells to keep the shoots upright in the water
    d. They have a reproductive cycle with both sexual and asexual stages to increase their chance of survival
3. Seagrass belongs to the group of:
    a. Seaweed
    b. Flowering plants (angiosperms)
    c. Mosses
    d. Algae
4. An organism which has a soft body, no segmentation, mostly has a shell and moves with a large muscular foot would belong to the phylum:
    a. Mollusca
    b. Echinodermata
    c. Crustaceans
    d. Chordata
5. An adult tiger prawn lives on the Continental Shelf a short distance off the coast in depths averaging 50 meters. Which of the following sequences represent the reproductive cycle of the prawn after spawning?
    a. nauplius-->zoe-->mysis-->postlarval stage --> adult
    b. Fertilisation-->nauplius-->zoea-->adult
    c. Fertilisation-->zygota-->juvenile-->adult
    d. Fertilisation-->planula larvae-->juvenile-->adult
6. Which of the following organisms is a gastropod?
    a. Clam
    b. Squid
    c. Octopus
    d. Limpet
7. Which of the following organisms have radial symmetry?
    a. Clam
    b. Crab
    c. Starfish
    d. Sponges
8. Coral polyps are similar in build and shape to the common sea anemone. Corals however belong to the phylum:
    a. Mollusca
    b. Coelenterata
    c. Crustacea
    d. Echinodermata
9. Sometimes each polyp is both male and female. It contains male and female gonads in the same polyp. These organisms are:
    a. Bisexual
    b. Planula
    c. Gonochoric
    d. Hermaphroditic
10. Which of the following statements concerning corals is FALSE?
    a. Corals are capable of regeneration whereby a new coral replaces a damaged coral
    b. Coral tentacles are armed with nematocysts which kill its prey
    c. Corals secrete a small cup shaped structure of limestone known as corallite
    d. Corals reproduce in late spring or early summer

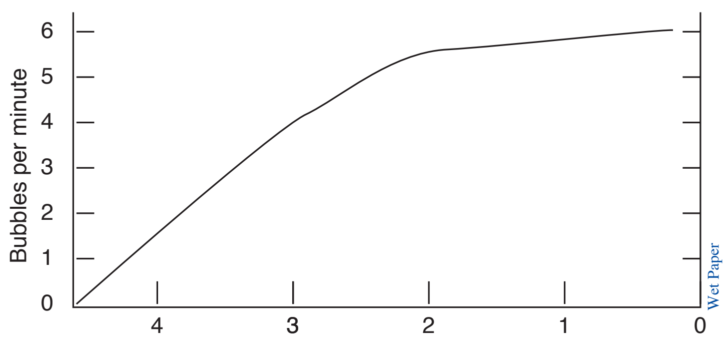
11. Label the internal features of the Cephalopod below:



Information processing and reasoning questions

Information for the next three questions

Green algae was placed in a large test tube filled with water and illuminated with light of differing intensity. The bubbles produced by the algae were counted for one minute. The illumination was altered by moving the light source towards or away from the test tubes. The results were as follows:



Use the following key to answer the questions 12-14.

A. The statement is a reasonable conclusion.

B. The statement is false according to the graph.

C. There is insufficient evidence to establish this fact.

D. The statement is not a conclusion but merely a restatement of results.

12. Light is the only limiting factor affecting the production of bubbles:
    a. Alternative A
    b. Alternative B
    c. Alternative C
    d. Alternative D

13. The temperature increases the rate of production of bubbles:
    a. Alternative A
    b. Alternative B
    c. Alternative C
    d. Alternative D

14. As the distance from the light source increased the number of bubbles produced increased:
    a. Alternative A
    b. Alternative B
    c. Alternative C
    d. Alternative D

15. What are zooxanthallae and to what purpose do they serve the coral polyp?

16. Where is the anus found in the starfish in relation to its mouth?

    What adaptation significance is this?

Information for next two questions

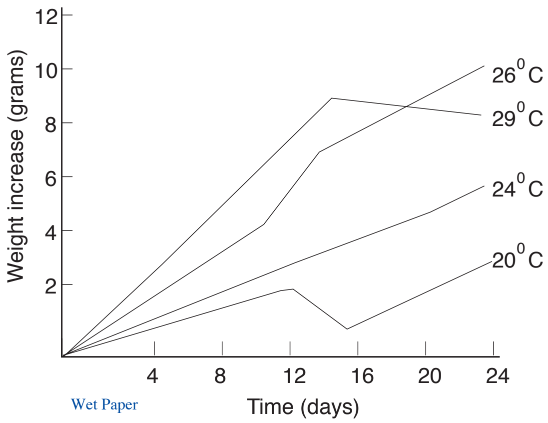
Reef building corals flourish in shallow tropical waters, rarely being found below depths of 60 meters.

An experiment was conducted to determine the optimum temperature for coral growth.

Coral of the same species were placed in similar aquariums and the temperature in each was regulated.

The weight of the coral was determined every four days.

The results are as shown below.



17. The results indicate:
    a. Temperature had no effect on growth.
    b. The growth rate was most rapid at 29 degrees centigrade for the first 12 days.
    c. A disease affected the aquarium at 20 degrees on the 12th day.
    d. Light, not temperature, affects growth.

18. The coral was then placed in the dark and the experiment was repeated. The expected results would be;
    a. No change as corals are animals and are not affected by light.
    b. The corals would lose weight at a constant rate because of respiration.
    c. The water would become dark and murky.
    d. Growth rates would increase for the first few nights as corals normally feed at night.

These questions refer to the graphs on Page 197.

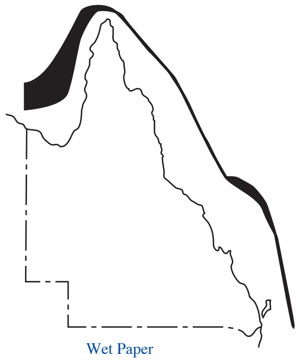
19. Prawns are a major fishing industry in Queensland with its largest landing coming from the Gulf of Carpentaria. Most are caught with otter trawlers.
    a. Determine the catch of banana prawns in 1980 - 1981.
    b. What percentage of the total number of prawns caught that year were banana prawns?
    c. Suggest two hypotheses to account for the fluctuation in catch size over the last ten year period.
    d. What was the average yearly catch between 1974-1975 and 1978-1979?
    e. The Gulf fishing area has a limited entry with about 290 vessels. Extrapolate the graph predicting the harvest in 1981-1984 if this limited entry was removed and trawlers from Asian countries were allowed entry into this fishing area.

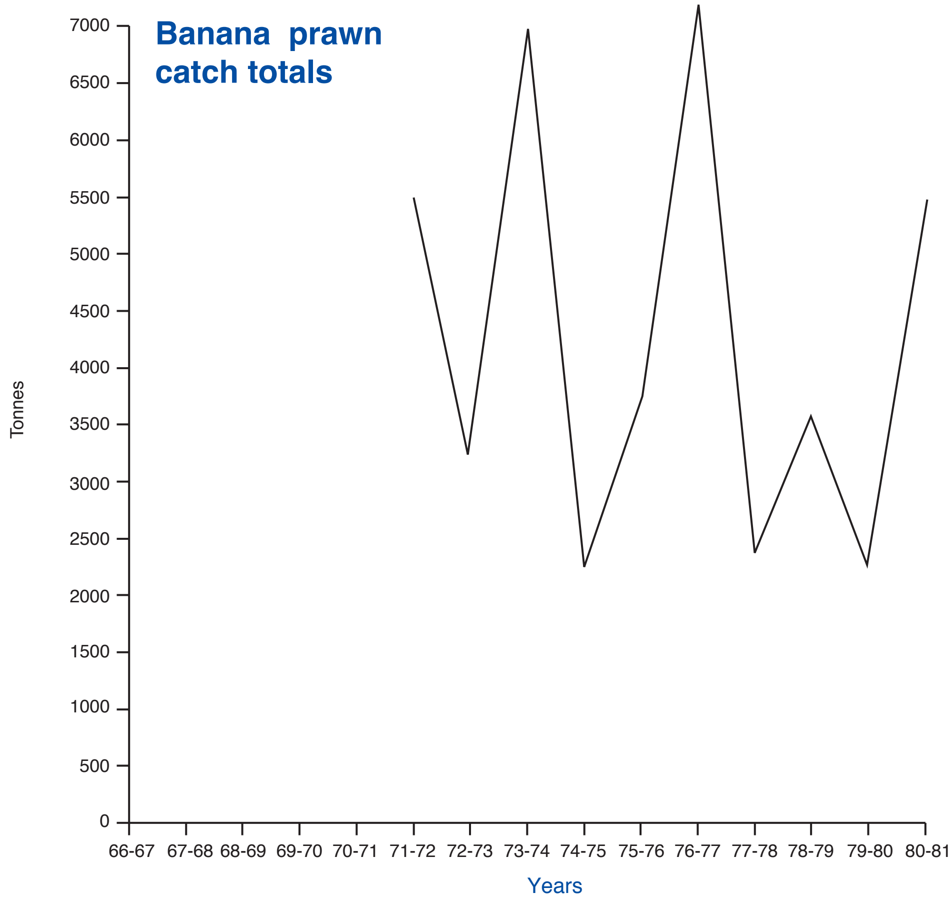
       Explain your reasoning behind these predictions.
    f. Benthic animals will be severely affected by human pollution.

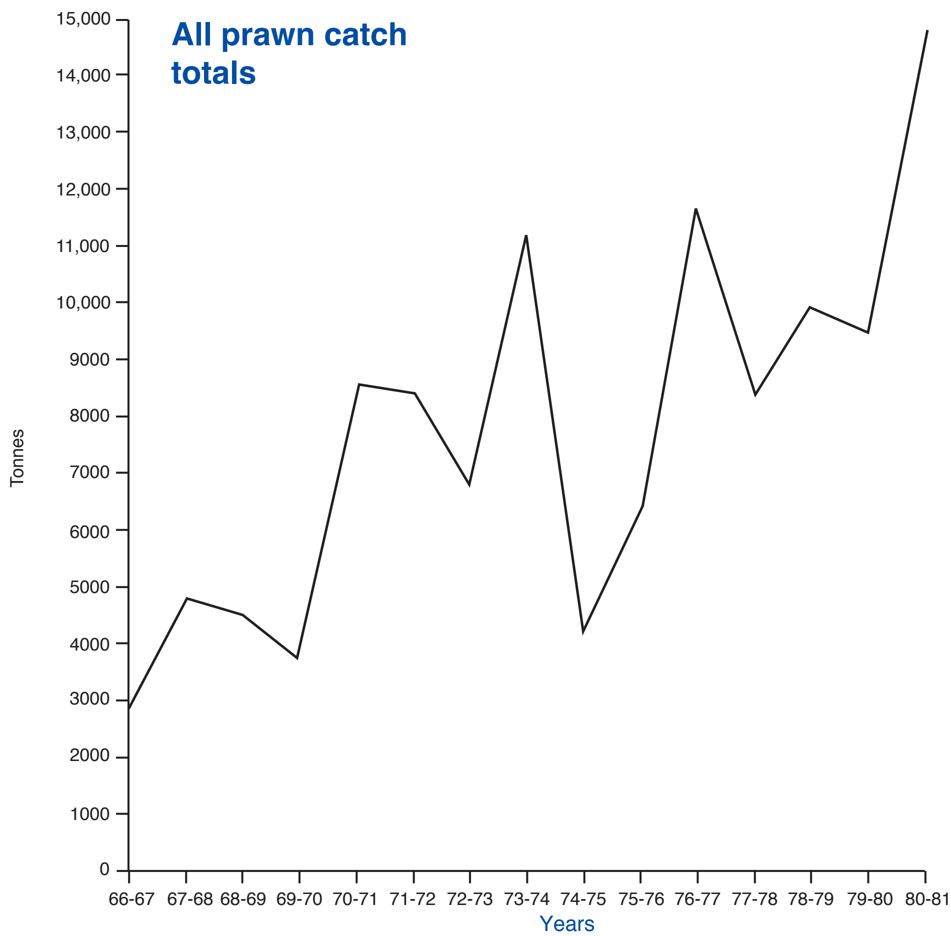
       Explain why many scientists are making this statement and discuss how the benthic animals may be affected.

Answers

1. a	9. d
2. b	10. a
3. b	12. c
4. a	13. c
5. a	14. b
6. d	17. b
7. c	18. d
8. b	


Wet Paper


Banana prawn
catch totals
Tonnes
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
66-67 67-68 68-69 69-70 70-71 71-72 72-73 73-74 74-75 75-76 76-77 77-78 78-79 79-80 80-81
Years


All prawn catch
totals
Tonnes
15,000
14,000
13,000
12,000
11,000
10,000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
66-67 67-68 68-69 69-70 70-71 71-72 72-73 73-74 74-75 75-76 76-77 77-78 78-79 79-80 80-81
Years

EXERCISE 89 RESEARCH QUESTIONS

Based on an original set of questions by Ward Nicholas, Rochedale SHS

Information processing and reasoning

1. Diatoms reproduce by a process known as fission. Why is the diatom population sensitive to its environment? (It may help to consider the process of reproduction and what it means to the diatoms gene pool.)
2. Noctiluca scintillans has a bioluminescent ability. How might this aid in survival?
3. Barnacles live near the surface in what could be considered a harsh environment. What adaptations has enabled the barnacle to survive and discuss these in relation to their feeding habits?
4. Discuss the problems a shark may experience when attempting to feed in a low visibility environment.
5. Consider the various commercial fishing techniques that make use of nets. These nets may cause environmental damage. Discuss the advantages of each method and outline procedures which could be implemented to protect the environment.
6. Many dolphins are killed each year by the accidental trapping in nets even though they have the ability to easily locate objects as small as 1 mm in diameter. Dolphins are generally regarded as intelligent so explain why they fail to jump clear of the fishing nets?
7. Sea grass beds are considered to be of great ecological importance. Many crab and prawn species spend considerable time in these beds. How could a major change to the environment, such as a marine development, effect the life cycles of seagrasses and prawns?
8. Some echinoderms undergo an unusual process when they loose a portion of their body. Outline this process and discuss its significance to medicine.
9. A marine biologist conducted a growth study on an intertidal species of crab over a 9 month period. Her measurements of carapace width through time are shown below:

Time (months) (after start of experiment)	1	2	3	4	5	6	7	8	9	10
Carapace width (mm)	10	15	15	29	42	42	52	52	57	57

   a. Draw a line graph of these results. Axes should be labelled and the graph titled. Use the graph paper supplied with your answer sheet.
   b. According to your graph, when is the greatest rate of growth?
   c. Bearing in mind the type of animal that was being investigated in this growth study, give an explanation for the shape of your graph.
10. Consider the following statements about the Coral Trout (*plectropoma leopardus*) and coral reefs:
   - Adult Coral Trout are non-nomadic and overall, do not range far.
   - Coral Trout spawn (ie. release eggs and sperm) in early summer on the Southern Great Barrier Reef.
   - Phytoplankton ‘blooms’ occur during the summer months on the Great Barrier Reef.
   - The spawning grounds of coral trout are always on the seaward edge of slope of the reef and are close to deep water. Many such areas are often near the mouths of channels through the reef, ie. areas of current.
   - Coral Trout apparently spawn around dusk during the spawning season.
   - Coral Trout have planktonic egg and larval stages - there is no parental care. The eggs are pelagic, spherical and contain a single oil droplet.
   - Spawning involves a “spawning rush” - a male and female pair rapidly rush up towards the surface away from the sea-bed. Eggs and sperm are released close to the surface.
   - There is little information on the length of time the eggs and larvae of Coral Trout drift before the young fish settle, but a period of roughly 30-40 days is probable. Even a 3 knot current drift over 14 days gives a thousand nautical miles of range for a developing egg and larval fish before settling.
   - Many benthic invertebrates of coral reefs are planktivorous, e.g. corals.
   - Planktivorous Damsel fishes actively feed throughout the water column (ie. from sea-bed to water surface) during daylight hours. As night approaches most move down towards the sea-bed where they eventually “sleep” in coral crevices, under coral boulders etc.

   Taking the above information into account, discuss fully:

   a. how the reproductive strategies of Coral Trout (e.g. spawning time (seasonal and time of day), spawning location, spawning behaviour, etc.) help to increase the chance of survival of individuals of this species.
   b. any implications these reproductive strategies have for the management of Coral Trout populations on reefs within the Great Barrier Reef Marine Park.

COMMERCIAL USE OF THE SEA

EXERCISE 90
ABALONE STOCK

Based on an original exercise by Tim Ryan, Maryborough State High School.

Acknowledgement is given to the Australian Fisheries Management Authority for permission to reproduce the article from Australian Fisheries August 1983.

QUESTIONS

Read the articles in Figures 90.1 to 90.2 and answer the following questions.

1. Describe the habit of the abalone and what do they eat?
2. Which species of abalone are commercially harvested off the New South Wales coast?
3. At what time of the year do the abalone spawn?
4. How are the abalone collected?
5. Suggest how information on the changes in stock densities can be gained.
6. Explain the term 'turnover' stock.
7. One of the difficulties of the catch statistics method is that it only concentrates on the total biomass of the population. Why is this a problem?
8. In what year was the highest catch reported and state the amount of abalone caught?
9. Interpret the information on abalone catches between 1965-1982.
10. It has been suggested that these figures are not accurate. Suggest some reasons why these figures might not show the full picture.
11. Outline some reasons for:
    a. the license limitations that were introduced in 1980.
    b. the increase of the legal minimum length from 100 mm to 108 mm in 1980.
12. Define the term 'catchability' co-efficient between 1977 and 1980.
13. Refer to the yield-revenue curve (Figure 90.2). Suggest why a reduction of number of fishermen from the current number of 59 to 49 is desirable.
14. How many divers would give the greatest difference between revenue and cost?
15. Do you think that the minimum size should be increased? Explain your answer.
16. Biological and economic data on fisheries tends to be imprecise. Does this imply that conclusions drawn from models are invalid?

Turn over to read the articles ... /200

NSW abalone stock assessment shows effort should be reduced

by Gary Hamer, Division of State Fisheries, NSW Department of Agriculture.

Recent analysis of biological, economic and catch statistics indicates that a reduction of total effort in the New South Wales abalone fishery is desirable in terms of current management goals.

The fishery

Abalone are marine snails that inhabit rocky reefs around the cool temperate coasts of continents including Australia. Several species are harvested commercially but only the blacklip abalone *Haliotis ruber* is fished off New South Wales.

Individuals of this species remain in one area for most of their lives - most tagged abalone have been found within 30 metres of where they were replaced.

The sexes are separate and spawning appears to take place during summer, although this is variable. The diet of *H.ruber* consists mainly of pieces of seaweed found drifting on or near the bottom. Detailed accounts of the biology of five species have been published in previous issues of *Australian Fisheries*.

Abalone are collected individually by skindivers who prise them from rocks using chisel shaped abalone irons. The abalone are placed in mesh collecting bags and are lifted to the surface by an inverted, air filled bag (a diver's 'parachute').

There are 59 licensed commercial abalone divers in New South Wakes. Each holds a restricted fisheries permit as well as a commercial fishermens's license. The current value of their catch is nearly $2 million. Almost all of the catch is exported.

Because of the biology of the species, its relative accessibility to divers and the high unit price ($3-4 a kg), abalone populations are very susceptible to high exploitation rates, so for proper management of the fishery it is extremely important to access the effect that fishing has on the stock.

This article presents a summary of some of the research carried out to enable New South Wales State Fisheries to make such an assessment. Much of the field work was funded by the Fishing Industry Research Trust Account and was carried out with the co-operation and assistance of the abalone fishermen of New South Wales.

Catch statistics

Substantial landings began in 1963 and the catch rapidly increased to a reported maximum of 960 tonnes in 1971 (Fig 1). Total catch then declined for several years as the effects of fishing were felt; it has now stabilised at about 600 T (liveweight) a year.

While total catch data give some indication of the general condition of a stock, a better understanding of changes in stock density can be gained from an analysis of catch per unit of effort (CPUE). Fig 2 shows the trends in catch per diver month and catch per diver day, two measures of CPUE. Declining stock density after 1971 to a minimum in 1977 is clearly evident.

Declining stock density is usually interpreted by fishermen to indicate an imminent collapse of the fishery. This is usually not the case and this fishery provides a typical example. The decline merely indicates that the fishery is passing through a transition phase from harvesting the 'virgin' stock to harvesting the annual 'turnover' of the stock.

It is this 'turnover' of the stock that is of the most interest because it approximates the long-term sustainable yield of maximum average yield (MAY). It is often a third to a half of the maximum catch.

Catch and CPUE statistics such as those shown in figures 90.1 and 90.2 can provide an estimate of MAY, if certain assumptions are made. Data for the New South Wales fishery were analysed according to the method described by Schnute. The theoretical MAY for the fishery, if all assumptions are valid, is 700 t.

Biological approach

One of the difficulties of the catch statistics method is that it concentrates on the total biomass of the population but ignores its age structure. Two populations with the same biomass could be made up solely of juveniles or adults. These two populations would respond to heavy fishing in quite different ways.

It is therefore necessary to examine in detail, certain biological characteristics of the population. A separate estimate of sustainable yield can then be obtained by calculating the yield per recruit to the fishery and multiplying that yield per recruit by the average number of recruits.

The information needed to do this is: growth rate; recruitment estimate; natural mortality rate; and fishing mortality rate.*

A future article will outline the methods used to calculate growth, recruitment and mortality rates.

*The values used for the yield assessment reported here are;

W_{inf} (average maximum weight attained) = 820 gms;

L_{inf} (average maximum length attained) = 160 mm;

K (relative rate at which L_{inf} is approached) = 0.3;

t_0 (the theoretical age that length would have been 0 mm if the abalone had strictly followed this mathematical growth pattern) = 0.28 yrs;

A (natural mortality rate) = 19 per cent per year; and

R (average number of recruits) = 2.2 million.

Fishing mortality

The main aim of determining the rate of fishing mortality was to determine the 'catchability coefficient' of individual abalone - that is, the proportion of the stock that is removed by one unit of fishing effort (one diver day).

This was done using the growth parameters already determined and the mean length of abalone in the catch from 1977 to 1980. From this information, a total mortality estimate was made and the catchability co-efficient then deduced from total mortality rate and total fishing effort.

Fishing mortality was found to be 60 per cent annually. Annual average fishing effort was 5800 days between 1977 and 1980 so the catchability co-efficient was calculated as 0.00016 per day (that is one per cent of the standing stock is caught in an average year by one diver).

Equilibrium yield (average catch)

When the above information is available a mathematical relationship between average catch and fishing effort can be derived. The relationship is a curve as shown in Fig 3; its exact position will vary depending upon the minimum length prescribed.

The curve shown in Fig 3 is the best representation of the New South Wales abalone fishery and is based on the parameter values presented earlier in the article. It relates to the current legal minimum length of 108 mm and assumes an average of 92 days fishing a year.

The highest average sustainable yield achievable using the current legal minimum length is about 625 t.

Figure 90.1 Article from Australian Fisheries August 1983

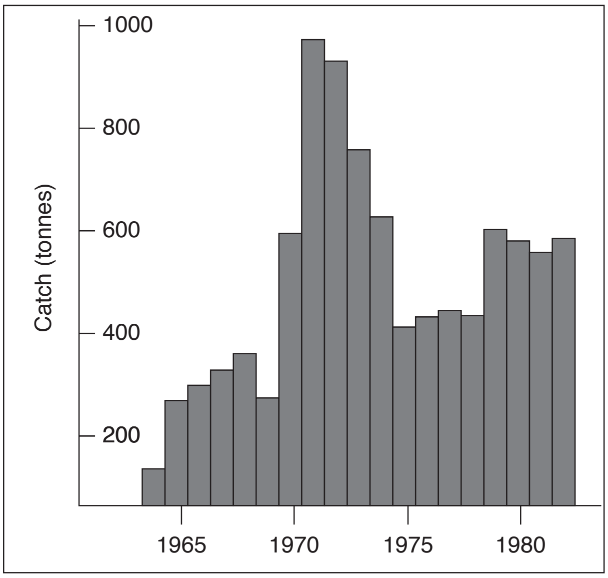


Fig 1 Total reported NSW abalone catch

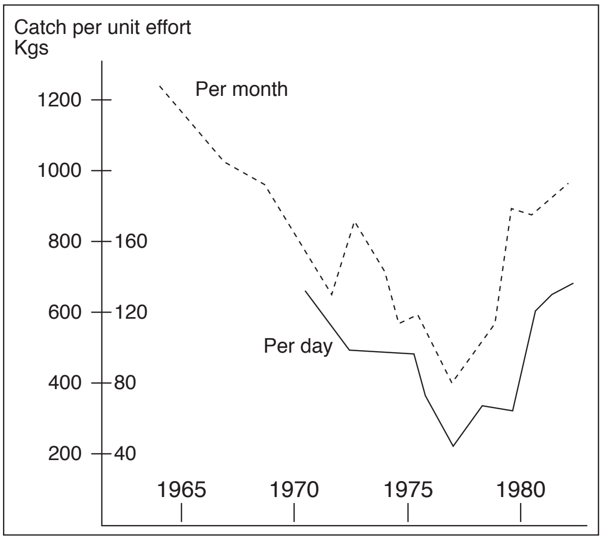


Fig 2 Catch per unit of effort for the NSW abalone Fishery. Licence limitation introduced in 1980.

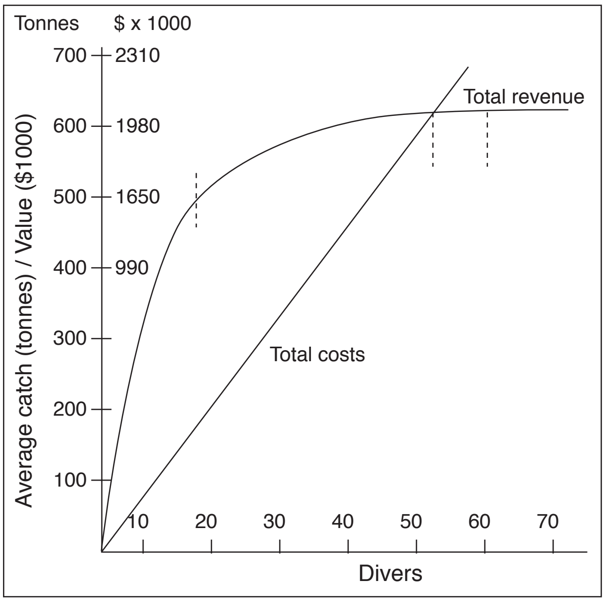


Fig 3 Yield revenue curve - yield converted to revenue using $3.30 a kg.

'Critical size'

The ideal legal minimum length for a fishery. If total catch is the only factor considered, is the one which results in the average length of fish in the catch being equal to the 'critical' size. This is the size at which addition of biomass to the stock is exactly balanced by losses of biomass through mortality.

The data presented earlier, when applied to the formula of Alverson and Carney (Ref 1.), indicate a critical size of 130 mm. The current mean size in the catch is 120 mm, and the legal minimum length (LML) is 108 mm. If the LML is increased (to 115 or 120 mm), long term sustainable yield would be higher than the 625 t indicated above, but there are many repercussions of an increase in LML and, when other factors are considered, such an increase may be undesirable.

Deriso analysis

A method of analysis combining catch statistics data and biological parameters was recently developed by Deriso (Ref 2).

This method of is one of the most sophisticated stock assessment methods available. It has been applied to the available data and the sustainable catch estimate varied from 600 to 700 t using various recruitment values.

It was noted that in all cases the computerised searching routine for optimum parameter values attempting to generate higher recruitment values and higher catchability estimates than those used. This indicates that the current recruitment level could be increased by allowing the adult population to increase.

Economic analysis

There has been much controversy between biologists and economists in the past over fishery management strategies - most of it due to poor communications and a lack of understanding - but on some points agreement has been reached.

One such point is the premise that trying to harvest the maximum sustainable yield is not a satisfactory management goal; other factors, including economics, must be considered.

In order to study the economics of a fishery a yield curve, such as is shown in Fig 3, can be converted to a revenue curve by multiplying yield values by price ($ per kg). A cost curve is then superimposed on the revenue curve to enable a simplistic economic analysis.

For this fishery a simplified cost line is derived from a report by Waugh (Ref 4.) Several options for a 'reasonable' unit cost were determined and, pending further discussions with industry representatives, the costs of operating a 5.6 m twin hull vessel with a deckhand (Option 4) are being used as a reasonable average costs. These costs in 1982 values are approximately $41 000 per vessel.

Fig 3 shows that the break even point for the fishery (where costs equal revenue) is near 49 divers and the maximum economic rent position (where the difference between revenue and costs is greatest) is near 17 divers.

Fishing power - reef area analysis

Another (very approximate) method for determining an appropriate level of effort for the fishery is to combine estimates of the fishing power of divers and the total area occupied by the stock. Fishing power was calculated from the effort expended in commercial harvesting of a research closure with a known reef area and density. The estimated obtained was 1100m^2 covered per hour. Consideration of the assumptions involved indicated that this value, if not correct, was too low. References for this article can be obtained from AFMA PO Box 7051, Canberra Mail Centre 2610. Please quote Australian Fisheries August 1983, Pages 7-10.

Figure 90.2 Article from Australian Fisheries August 1983 (Cont'd)

Exercise 91 The Australian herring

Questions

Read the boxed section and study the illustrations in Figures 91.1 and 91.2 and answer the questions below.

1. Where do adult Australian herring live?
2. When are the commercial and recreational fishing seasons in Western Australia and South Australia? When do you think the best time would be to go fishing season Victoria?
3. Why don't the fish get to Tasmania?
4. Where do the juveniles develop? What do they eat on?
5. Why do we have to keep pollution out of our coastal waters?
6. How long does it take for a herring to grow to be an adult?
7. What is a spawning run and where does it go to?
8. What is the idea behind a fishing season?
9. Why have a fishing season at all?
10. Draw a diagram to show how a fisher would catch a school of herring from the beach with a seine net.
11. What is a rollmop? Have you ever tasted one? Did you like it? What European communities love rollmops?
12. What is the legal size of Australian Herring?

The Australian Herring

The following article is adapted from The Australian Herring, Fishing WA No 3. For copies of the full article, you can write to Fisheries Department of WA, 108 Adelaide Tce, East Perth 6004.

The herring found in Australian waters is also known as a tommy rough, ruff or sea herring and is a great fish to eat.

Herrings are silvery in colour with rows of vertical spots as shown in Figure 91.1. Their maximum length is about 40 centimetres and can be caught at 25 cm.

They are found south from Shark Bay in Western Australia, in estuaries and bays right across the Great Australian Bight and in South Australia. In Victoria they are found in bays and estuaries all the way to Port Philip Bay.

Adults usually mate in Western Australia where they spawn in the warm coral reefs. The Leeuwin current mixes the sperm and eggs which quickly fertilize and grow into larvae. The current takes the larvae on a trip almost one third of the way around Australia past Perth and Albany to Adelaide and Melbourne. Along the way the larvae are distributed by offshoots of the current in bays and estuaries.

In these sheltered areas the larvae grow into juveniles in the protected waters and feed off the sea grass beds and small crustaceans that inhabit the cooler waters of Australia.

Some enter the coastal estuaries and feast on the rich inshore life and grow larger and fatter than their coastal relatives.

When they are about three years old, they hear the call of the west and undertake a perilous journey back across the bight in a spawning run which finishes in the reefs off Western Australia, Tagging experiments have shown that some fish can travel up to 2190 kilometres.

Fish are caught from boats with lines and recreational net fishing is mostly prohibited. The only other restriction is on size with the minimum legal size set at 18 centimetres (total length).

The commercial fishery is operated by a licence system which has a season. The idea is that the fish are given enough time to migrate and spawn – then it's every fish for itself as the season opens. Fishers usually fish from the beach with a boat that goes a short distance out to sea. The boat carries a seine net and the skill of the skipper is used to circle the herring. A large loop is made around the school and the skipper then drives ashore. The net is drawn closer and closer by helping hands or four wheel drives and gradually the fish are entrapped and hauled up the beach where they are quickly taken to market.

Australian herring are usually eaten fresh and freezing is not recommended as the fish tends to loose their texture when thawed. Herring make excellent fish for smoking but are usually pan fried, grilled or rolled into circles and soaked in pepper corns and onions and eaten raw.

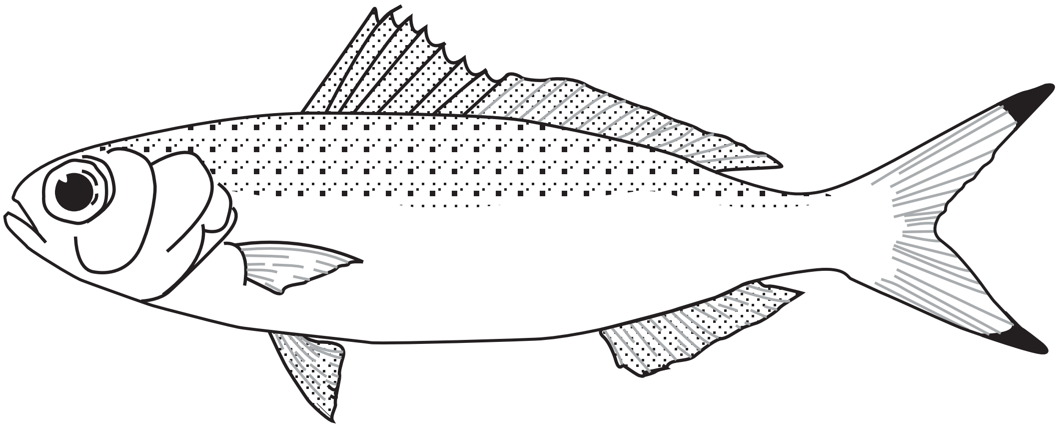


Figure 91.1 Australian herring (schematic only)
Wet Paper

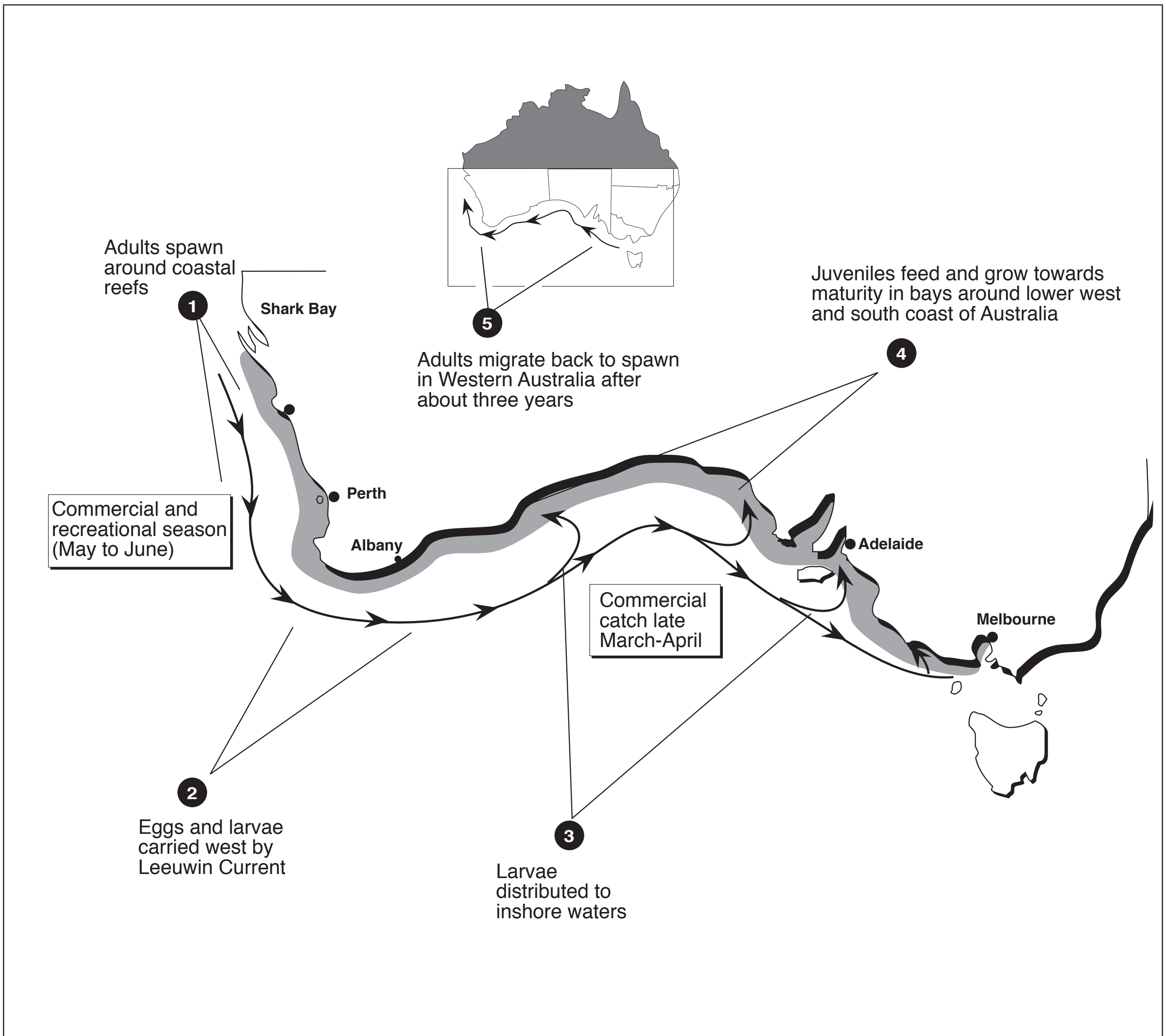


Figure 91.2 Australian herring life cycle (Hutchins and Swainston (1986) in Fishing WA No3, 1983)
Wet Paper

Exercise 92
South East Fishery

Based on an original exercise by Tim Ryan Maryborough State High School. Acknowledgement is made to the Australian Fisheries Management Authority for permission to reproduce the article from Australian Fisheries June 1994 , Page 13.

Questions

1. Explain the following terms:
   a. SEF Species
   b. percent of TAC
2. What was the total catch in kilograms for the following species in the South East Fishery in 1994?
   a. flathead
   b. John dory
   c. school whiting
   d. silver trevally
3. a. What was the most expensive fish at the Melbourne markets in April and give its price per kilogram?
   b. What was the lest expensive type of fish sold at the Sydney markets?
4. Calculate the value of the following fish going through the Melbourne market in April:
   a. flathead
   b. orange roughy
5. What species of fish showed the greatest variation in prices between Melbourne and Sydney markets?
6. Suggest two reasons for the fact that 129 990 kg of blue genadir went through the Melbourne market and only 960 kg were sold at the Sydney market.
7. Calculate the total catch of the following species in Commonwealth waters:
   a. school whiting
   b. blue eye trevally
   c. flathead
   d. redfish
8. Name the three species that made up over one third of the South East Fishery.
9. If it takes 200 kg of fish to fill the average household freezer, how many such freezers would be filled with the catch of orange roughy in South East Fishery?
10. Suggest why the percentage of total TAC of school whiting and silver trevally was so low in the SEF.
11. Explain some of the limitations and sources of errors in the information presented.
12. a. Why do you believe a Strategic Plan for research in the SEF needs to be developed?
    b. What do you predict will be some of the priorities for the fishery?
    c. Suggest why the priorities developed will be released for public comment.

April	Melbourne Wholesale Fish Markets		Sydney Fish Markets	
SEF species	Quantity in kilograms	Average price ($)	Quantity in kilograms	Average price ($)
Blue eye trevalla	10 230	5.51	16 281	6.89
Blue grenadier	129 990	2.87	960	2.31
Blue warehou	84 450	2.78	2455	2.11
Flathead	63 870	2.09	70 700	2.93
Gemfish (whole)	7650	4.43	7202	5.40
Jackass morwong	21 780	1.66	48 187	2.72
John dory	3570	2.26	18 536	5.20
Ling (whole)	30 060	4.15	19 560	4.79
Mirror dory	1920	2.15	5761	2.54
Ocean perch	2370	3.85	11 153	4.04
Orange roughy	82 290	4.39	--	--
Oreo dory	13 500	1.83	--	--
Redfish	14 880	1.27	74 938	1.80
Royal red prawn	--	--	17 484	0.73
School whiting	25 770	1.73	--	--
Silver trevally	32 160	1.41	33 383	1.79
Smooth dory	--	--	--	--
Spotted warehou	65 970	1.91	14 223	2.53
Arrow squid	20 850	1.38	88	3.02

Source for Sydney Fish Market report: ABARE
Quantities and prices have been aggregated for various grades/ classifications for each species

Figure 92.1 Comparison of Sydney and Melbourne markets

South East Fishery Update

Stock assessment

Draft fisheries stock assessments are being completed for all SEF quota species following the first round of Fisheries Assessment Group meetings for 1994. Draft assessments are being forwarded for comment to those who attend the meetings, prior to final consideration at the fisheries assessment plenary meetings to be held during the week 11-15 July.

The CSIRO in conjunction with the AMFA and State fisheries agencies is undertaking risk analyses for different harvest strategies for orange roughy and eastern gemfish which will be incorporated into the fisheries assessment process.

Setmac research sub-committee

The SETMAC Research Sub-Committee has been meeting to develop a Strategic Plan for research in the SEF, which will include a statement for research priorities for the fishery. Following SETMAC endorsement for the Research Plan will be released for public comment.

Western zone orange roughy Survey

SETMAC 44 held in Canberra on 10 March 1994 agreed that it would be worthwhile repeating the 1993 Western Zone orange roughy survey. Eight operators submitted expressions of interest prior to the cut-off date of 20 May 1994. The survey is to commence in the second week of July and will go for four weeks. Vessels will conduct north-south acoustic transects covering depths from 700-1400 metres in 40 nm strips from Portland to the west. Participants for the survey were selected on the basis of expertise and experience of the skipper and vessel, with preference given to vessels with proven familiarity of the area.

Non-trawl consultative committee

AMFA has recently established the NTCC to discuss and develop management arrangements for Commonwealth no-trawl operations in the SEF. The first meeting of the NTCC is expected to be in late June. Anyone interested in the agenda and meeting dates and venues should contact Anna Willcock on (06) 272 5179.

Catch versus TAC (as at 23 May 1994)

SEF species	Catch in kilograms	% of TAC in kilograms	% of TAC caught	TAC
Blue eyed trevalla	52 120	125 000	42	
Blue grenadier	1 034 188	10 000 000	10	
Blue warehou	219 803	1 000 000	22	
Flathead	593 451	3 500 000	17	
Gemfish (east)	28 068	0		
Gemfish (west)	48 267	300 000	16	
Jackass morwong	370 155	1 501 239	25	
John dory	41 127	240 505	17	
Ling	242 820	1 000 068	24	
Mirror dory	63 680	800 174	8	
Ocean perch	83 032	500 000	17	
Orange roughy (east)	233 113	1 500 000	16	
Orange roughy (south)	2 108 811	5 000 000	42	
Orange roughy (west)	79 429	1 500 000	5	
Redfish	84 699	600 003	14	
Royal red prawn	168 946	500 000	34	
School whiting	172 826	2 000 000	9	
Silver trevally	41 915	500 001	8	
Spotted warehou	416 111	2 500 225	17	

This table shows the total catches (declared as being caught in Commonwealth waters in the SEF) of individual quota species as a percentage of the TACs for those species in 1994.

Reported catches of orange roughy in the southern zone topped 2000 tonnes by late May accounting for 42 per cent of the annual TAC. A further 20 tonnes of blue eye trevalla and 65 tonnes of royal red prawn caught since last Catch Watch pushed the totals for those species to 42 per cent and 34 per cent of their annual Tacs.

Monitoring contacts:

Jahon Davis: (06) 272 4511

Ian Freeman: (06) 272 5298

Shane Spence: (06) 272 5659

References for this article can be obtained from AFMA PO Box 7051, Canberra Mail Centre 2610. Please quote Australian Fisheries June 1994, Page 13.

Figure 92.2 South East Fishery article. (Data supplied by Australian Fisheries Service from Australian Fisheries June 1994. Reproduced with permission)

Exercise 93
Ecotourism

Questions

Read each of the tourist information boxes on Figures 93.1 and 93.2 and answer the following questions.

1. Which of the articles mention the term: biodiversity? Why is this an important tourism marketing strategy?

2. Look at Figure 93.2. Why is this form of ecotourism so environmentally friendly.

3. If you wanted to go whale watching at Victor Harbour, what would you do?

   What form of tourism does Victor Harbour offer?

4. Look at the photograph in Figure 93.1. Why is this form of ecotourism so environmentally friendly?

5. Why are rubber tyres used in Kakadu national park? Is this a suitable form of ecotourism? Why?

   Why are crocodiles mentioned in the article?

6. Where is Heron Island and what is it famous for? Imagine for a while that you are on a deserted tropical island. Write down all the things that you as a tourist would like to see.

   What would you expect to see on a reef walk?

7. What contribution can Aboriginal and Torres Strait Islander dreamtime stories make to Ecotourism?

Whale watching Victor Harbour

Situated a few hours from Adelaide is Victor Harbour. Each year you can drop in to the whale watching centre and learn about the biology and migratory patterns of whales. Listen to whale songs and watch a video of the local whales at play.

Each day whale spotting teams travel the coast to give you up to date information on the location of the whales so you can watch them from shore. The local whale is the southern right and pods frequent the shore line in the winter months.

Figure 93.1 Whale watching at Victor Harbour (Photo courtesy Les Leane with thanks to Ian Milne for assistance)

Kakadu National Park

Situated in the Northern Territory is Twin Falls. You have to drive about 65 km on a very rough track to reach the start of your ecotourism adventure. Guides have rubber mattresses that are used by tourists to float downriver to the falls.

Floating in warm crocodile free water between tall canyons, the guides tell interesting tales while you look at soaring canyon walls before you end up in a wide sand fringed pool. The guides organise lunch, telling aboriginal dreamtime tales while you soak up the scenery.

Snorkel Rotto

Jump on a boat at Fremantle for a short trip over to fabulous Rottnest Island. Free from cars, you can rent a bike and explore this magnificent island with its fabulous fringing reef. Surfers can ride the famous Stricklin Bay or you can fish off the water's edge. Overnight and weekend cabins are available for an extended stay at reasonable rates and the island has full services and amenities – post office, general store, hotels, library. You can hire snorkelling gear or take a dive trip from the professional dive shop on the island. Daily snorkel trips are available and bookings can be made from the store.

Explore Heron Island

Eight hours drive north from Brisbane airport is the bustling city of Gladstone and just a short 20 minute helicopter ride further on lies Heron Island.

Bathed in the tropical Queensland sunshine, this island offers a spectacular biodiversity of life unique to tropical waters. Thousands of coloured fish inhabit crystal clear coral pools, brightly coloured starfish crawl over the pure white sand and a maize of corals make a low tide ramble a real wonder.

At night you can be lulled off to sleep by the dulcet tones of the mutton bird and in the summer months be fascinated by thousands of sea turtles that come to lay their eggs each night.

You can hire snorkelling gear and take a snorkelling tour each day or have a reef guide walk you over the reef at low tide.

To dive the famous Heron bommie is a must for all divers who meet friendly moray eels sitting at the bottom. The island's dive instructors run weekly courses with all gear provided.

Fishing trips take you out from the island to places in the national park where fishing is allowed and overnight camping on a deserted island is just a few nautical miles off. You can really become at one with nature on these deserted island trips and share some special times with the Great Barrier Reef.

Visit the research station and talk with scientists who continually undertake reef studies as part of their research work. Each night rangers give information talks about the islands and reefs and are able to answer your many questions. Heron Island is a holiday with nature and has a low key nightlife.

Wet Paper

Figure 93.2 Ecotourism at Rottnest Island (bikes, wetsuits, surfboard, lunch!!!)

Exercise 94
Mariculture

Class project

Set up a aquaculture project area like the one shown in Figure 95.2. You could decorate your area as shown in Figure 94.1 and make a school feature of the project..

Research project

Based on original ideas by Dave Mason, Heatley SHS.

Prepare a project on the mariculture industry using your textbook and the following headings:

a. The need for aquaculture

b. Approaches to aquaculture; both extensive and intensive systems

c. Water quality including a discussion of inorganic substances, temperature, pH and waste products

d. Aquatic biology including reproduction, growth and disease

e. Setting up and operation including biological considerations, hatchery requirements, nursery

f. The outgrow facility and site selection

g. Other considerations such as technical, environmental and personnel

References and resources

- Austasia aquaculture, June 1991. Turtle Press. PO Box 279 Sandy Bay 7005.
- Aquaculture in Australia. 1986. QFMA Rural Press. Brisbane
- Jones, C.M. 1989. The Biology and aquaculture of the tropical crayfish, *Cerax quadricarinatus*, Queensland Department of Primary Industries Project No. QDPI / 8860 Ann St. Brisbane 4001
- Queensland Education Department Aquaculture Series by Don Fielder University of Queensland a very inexpensive - 6 books plus a lab manual, available from Go Print 371 Vulture St. Wooloongabba 4102 Telephone (07) 2463500

Project booklets

You can write for more Aquaculture materials and Marine Biology Projects to:

Sea World Services

PO Box 3304

North Mackay 4740

Phone/fax 079 424 734

or drop a line to Greg McGarvie or Nick McMorrow at

Pioneer SHS

North Mackay 4740

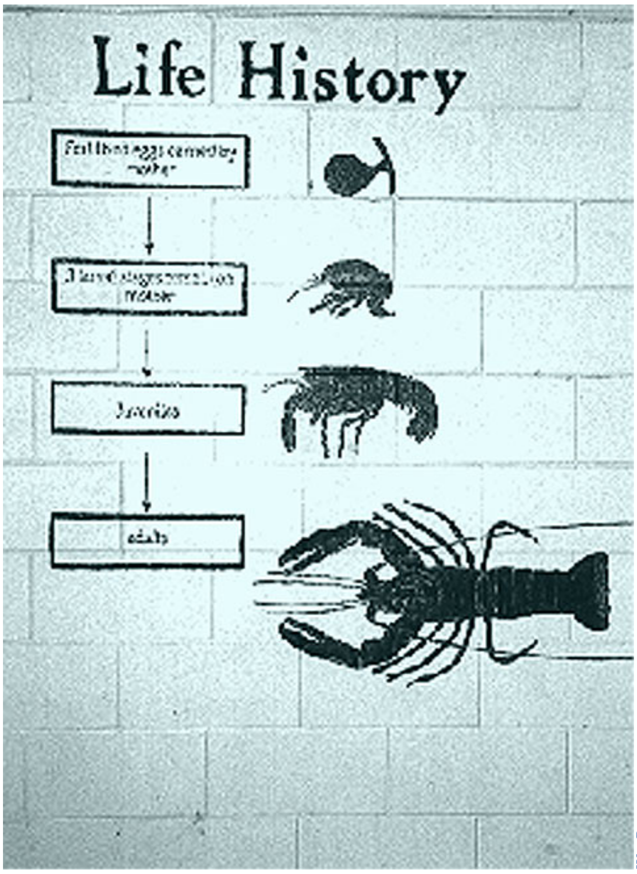


Figure 94.1 An idea from Pioneer SHS was to paint the walls of their Marine Studies Building with their project specimens

Figure 94.2 A school aquaculture facility (Photo courtesy of Greg McGarvie and Nick McMorrow, Pioneer SHS, original tanks by Paul Sumpter Mirani SHS)

Exercise 95 Aquaculture

Projects

Based on original exercise by Geoff Jensen, Innisfail SHS with original ideas by Dave Mason, Heatley SHS.

Method

1. Read Important Functions of a Culture in Figure 95.1.
2. Choose one the organisms listed in the materials and equipment section and set up the equipment necessary to establish a stock population of this organism. Ask your teacher to allocate an area for study that can be devoted to two or more weeks study. You need access to running water and electricity but at the same time a well aerated room, such as a plant room as shown in Figure 94.2

   Use your textbook Chapter 18 to help you.
3. When your culture has been set up, record the physical conditions (amount of salt water, amount of minerals, pH, height of light above culture, temperature etc.) in your notebook.
4. Continue to monitor the culture every second day and any conditions which may be variable (e.g. temperature, pH etc.).

   Record your results in a table in your notebook.
5. Use a plankton net slide (Refer to Activity 77 for construction details) to estimate the population density of your culture.

   Record the results in a table in your notebook.
6. Now choose either experiment A or experiment B from Figure 95.3 on Page 212.

Material and Equipment (per group)

Based on experiments done in Northern Queensland

- deep green algae (*Tetracelmis chui*)
- light green algae (*Nanochloropis oculata*)
- Brown diatom (*Chaetocerus gracilis*))
- rotifer (*Brachionus plictilus*)
- tank or large bottle
- aeration system
- suitable light source
- supply of sterile water
- appropriate mineral nutrients

Read this

This exercise investigates some of the factors which affect the growth rates of organisms used in fish aquaculture. In aquaculture, fish need food to grow, and the first step is to culture this food in a form that will promote the best growth conditions.

In this exercise you will study the culture which has three important functions:

1. To allow you to gain expertise in culturing an organism.
2. To determine conditions necessary for the growth of the culture.
3. To act as a control for comparison with later experimental cultures.

Figure 95.1 Important Functions of a Culture

Wet Paper

Figure 95.2 Suggested project room (Thanks David Mason)

Experiment A

Choose one of the following factors which could effect the survival and growth rate of your culture organism.

Determine how you can change this factor without effecting any other factors. For example you could modify one variable only.

Set up a culture with the variable you have chosen and, for a period of 10 - 20 days, monitor the physical conditions and population density in both your experimental culture and original culture (Control).

Record all results in a table.

Some of the factors which can be modified are as follows:

1. Light. Try no light or vary the light source at a different height above the culture.

   What about different light intensity?

   Use filters to create different colours or wavelengths.

   Ask you physics teacher for equipment to measure wave lengths.

2. Temperature. Use ice, room or heat the water in a water bath to study the different effects of temperature.

3. Minerals. Try sterile salt water only. Add different amounts of extra salt or nitrate/phosphate balances or no nitrate or no phosphate.

   Try some hypothesis such as - "does phosphate levels affect growth rate"?

4. Food. Experiment with the rotifers.

   Try adding no food and then set up other experimental tubes with one species of algae only or compare tubes with yeast and no yeast.

Presentation of results

1. Graph the results you obtained from each culture (population density v's time).

2. Compare the population densities and growth rates of the two cultures.

3. Explain what differences occurred and why these occurred. Can you attribute these differences directly to the variable factor?

Questions

1. What are some factors to consider when selecting an aquaculture species?

2. Why will aquaculture become more important is the future?

3. Why is so much importance placed on cleanliness in the hatcher.

4. What conditions are necessary to get barramundi to spawn:

   a. naturally

   b. in the hatchery

5. What are the causes of a failed hatch?

6. What food is fed to fingerlings?

7. What are rotifers - Phylum family?

8. What is the difference between a hatchery and a grow out area?

9. Describe the life cycle of the barramundi.

10. For how long are female barramundi productive?

11. At what age do barramundi males become females?

12. How is it that barramundi can live in both fresh water and salt water?

13. What term is used for fish that:

    a. Change sex?

    b. Live in both fresh and salt water?

14. What is the growth rate of the barramundi ?

15. At what temperature and salinity do barramundi grow best?

16. What size are barramundi when sent to the grow out ponds? How are they transported?

17. What are the characteristics which make mud crabs so hard to farm?

Experiment B

Set up an experiment involving the grow out of either barramundi fingerlings or red claw. Your textbook lists information on Page 558.

You will need to discuss your experiment with your teacher and then proceed to set it up as soon as possible after your teacher has looked at the draft.

Figure 95.3 Possible experiments

Excursion to a red claw farm

1. What are the objectives of the visit to the red claw farm?

2. Red claw tanks are aerated and managed for temperature and food. Describe how this is done.

3. Describe the system used for plumbing water to and from the tanks.

4. How is disease controlled?

5. How is the hatchery set up to produce juvenile red claw?

6. How are predators kept away from the tanks?

7. What systems are used to control water quality?

8. Who manages the facility from day to day?

9. Where are Red claw stocks obtains?

10. List any other points of interest.

Figure 95.4 Possible excursion data collection sheet.(**Based on an original exercise by Nick McMorrow and Greg McGarvie, Pioneer State High School)**

Exercise 96
Shipping

Acknowledgement is made to Peter MacGregor for permission to use questions from the booklet, Ships and Shipping.

Questions

Obtain a copy of the booklet Ships and Shipping from the address below and answer the following questions.

1. Why is trade important? How does the level of trade influence Australians' standard of living and what role does shipping play?
2. What are the differences between shipping today and shipping in previous generations?
3. How has micro-economic reform affected Australian shipping? How do these reforms improve Australia's capacity to compete in the global marketplace?
4. Investigate the work of an "Integrated rating" on board today's ships. What skills are required?
5. What were the main findings of the parliamentary report *Ships of Shame*? Why does international shipping have such a poor reputation and, in your view, is it deserved?
6. How important to Australian and New Zealand is our fleet of coastal ships? What do they mostly carry and from where to where?
7. Why do Australian ships carry such a small percentage of overseas trade? Should Australian ships carry more? Give reasons for your answer.

Research

You may like to research other industries associated with shipping as outlined in Figure 96.2

Materials and equipment

You will need a copy of the booklet:

Australian Ships and Shipping

Available from:

Australian Ship Owners Association
Level 1 40 Beach St
Port Melbourne 3207

or

The Centre for Economic Development
PO Box 334 Albert Park 3206
Telephone (03) 96996824

Other industries

Choose from one of these projects for a term report.

The diving industry

Contact your local dive shop and research the products that the shop has to offer. Present an industry profile on products and services associated with the marine environment and evaluate the effectiveness of the operation.

Find out how much it costs to do a dive course and what services the dive shop has to offer. Collect a folio of marketing brochures and analyse what is available.

Marine retailing

Use the phone book to write for a marine catalogue. Making a short presentation on any ten products from the catalogue, their uses, costs and application to marine industries.

Surfing and surfboard manufacture industry

What is the difference between a gorilla grip and a latex surface finish? The manufacture of surfboards has a lingo of its own and in this activity you are to research the meanings of different terms and products used in the surfing industry. Document the use and price range of body boards, thrusters, mals, goat boats, windsurfers and any other craft used to ride the waves and evaluate the use.

Tabulate any other information on wet suits, caps and wet shirts as well as other surfing products.

The boating industry

Contact your local boat retail shop and research any twenty products for sale. Tabulate your results and present a report on each product's use and popularity as a retail item.

The port industry

It takes a lot to get a ship to sea. There is fuel, crew, food, insurance, transport, control of equipment, garbage disposal to name but a few.

Locate a shipping broker or port office and find out how a port supports ships.

Find out how much additional costs are involved to use a port and containerisation.

You may like to do an exercise in exporting some goods to a foreign port.

Imagine you are an apple grower and want to export to Japan.

What things do you have to consider and what management things need to be put in place to make sure the goods get there and you are paid for your efforts.

Wet Paper

Figure 96.1 Other research project ideas

Exercise 97
Ecotourism

SURVEY

Based on an original activity by Geoff Jensen, Innisfail SHS

Questions

1. Obtain a copy of the kit – Ecotourism and Marine Life and notes from the following supplier:
   Sea World Services
   PO Box 3304 North Mackay 4740
   Phone/fax 079 424 734
2. Watch Video 1 called *Survey and Design of an Underwater Snorkelling Trail* and complete Figure 97.2.

Research

1. Find an ecotourism operator and conduct the following survey questionnaire. Ask the operator if you can interview a few of the passengers. It may be easier to invite the operator to class to answer some questions before you join the operator's tour (see Figure 97.2).
2. Go on the eco-tour and with the operator's permission, conduct the following interview with a tourist. Use the following as a guide only as you will have to modify these questions to suit your own area.
   a. Information required: Where does the person come from (local, Queensland, Interstate, Overseas)?

      Is he/she travelling by him/herself, in a group of friends, family, organised tour?

   b. Why did the person choose to visit the tourist site? What do they expect to get out of the day/week?
   c. What is the extent of the person’s knowledge of the tourist site?
   d. Are they aware of any of the main issues affecting the tourist site?
3. Make sure you do a tour yourself and make a summary of what you learnt. You should address the following issues.
   a. List the major management environmental issues on the site.
   b. For each issue find out the main causal factor and set them out in a table as follows:

Issue	Causal factor

   c. Which issue is the number one priority for action. Give some reasons.

Wet Paper

Figure 97.1 Select an ecotourist operation like this one at Port Douglas in Cairns

Questionnaire

1. Why was this venture started?
2. Who started this venture?
3. What was the original operation like?
4. What regulations were in place when the venture started?
5. Who decides the regulations and who enforces the regulations?
6. Which regulations are designed for safety of passengers and care for the environment?
7. What changes to the regulations have been made?
8. Can you suggest any reasons why these changes have been made?
9. Do you think these regulations are all necessary?
10. How many operators travel to this tourist site? Should there be a fixed number allowed?
11. What visitation trends do you forsee in the next ten years?
12. Are there any environmental problems caused by the venture?
13. Has the environment altered since the company started operation at the tourist site?
14. What numbers per week did you carry to the site in the first year of operations?
15. What numbers do you carry now?
16. What is the link between the tourist site and this company?
17. What do you think it is that attracts people to this tourist site?
18. What is it that people find most enjoyable about the tour?
19. What is the makeup of tourists travelling with your company?

Thank you.

Figure 97.2 Conduct your survey. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 98
Is tourism good for the community?

Based on an original exercise by Tim Ryan, Maryborough State High School.

Read the following article on Hypothetical Bay and answer the following questions.

1. The article states that, according to research carried out by the Mariner City University, by the year 2000 Hypothetical Bay will be attracting 2.3 times more visitors than present.
   a. How much extra food will be required?
   b. What other developments will need to be planned?
2. You are planning a trip to Hypothetical Bay for two weeks later on this year. Make a detailed budget for the trip e.g. to cover accommodation, entertainment, food, clothing, gifts and souvenirs, photography etc.
3. Discuss the statement 'tourism is beneficial for all people in the community'.
4. Comment on the statement 'Tourism may help the primary producers but not the professionals such as doctors, engineers and lawyers.'
5. If the average lamb carcass weighs 25 kg, calculate how many extra lambs will need to be produced to provide 6479.4 tonnes of lamb for the year 2000?
6. Calculate the tonnes of seafood being presently eaten by tourists from the data provided in Figure 98.1. Do you believe we will have problems supplying the extra 3239 tonnes by the year 2000?
7. Devise a list of occupations that will benefit from an increase in tourism.
8. Why would increase in shopping hours lead to a growth in tourism?
9. Look at the photograph in the article and suggest some of the negative effects of tourism.
10. Evaluate the idea of a special tax on tourists to increase revenue. If it was introduced, outline how the money raised should be spent.
11. Evaluate the mood/theme of the article Figure 98.1. Do you agree with the article?
12. List and rank in order the 8 professions which would most benefit from tourism.

Statistics make for a good cackle

Editorial comment

The tourism industry loves statistics and the Mariner City Times has long believed that more people are employed in it researching useless information than in actually working in resorts and restaurants.

The latest newsletter from the Hypothetical Bay Tourist and Travel Corporation does nothing to change this point of view.

It contains the startling revelation that, according to research carried out by Hypothetical Bay's Mariner City University, by the year 2000 the Bay will be attracting 2.3 times more visitors than at present.

It further points out that all these extra people will need feeding. As a result, in the year 2000, we will need to find an extra 6479.4 tonnes of lamb, an extra 1468.7 tonnes of butter, 17711 tonnes of citrus fruit, 3239 tonnes of seafood and an extra 4.82 million dozen eggs.

The Mariner City Times hopes someone warns the Bay's chook population that considerable overtime will be required of it in the years ahead.

Meanwhile you will be pleased to know that thanks to extended shopping hours the future of Conneltown is safe.

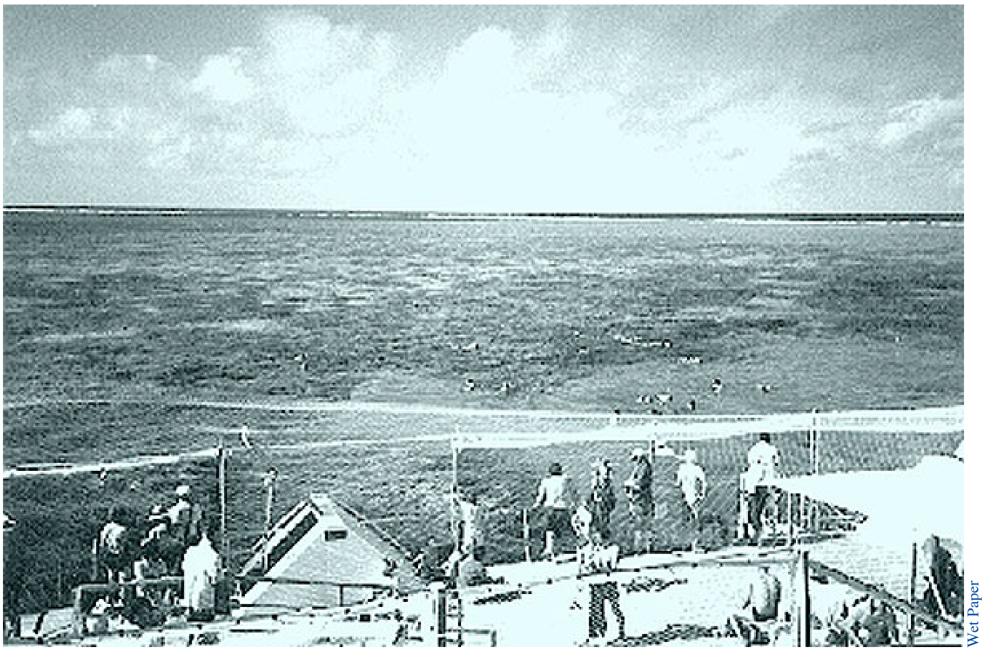
According to the CTTC chairman, Sir Frank Jones, the extra shopping hours are "a giant leap forward for tourism" and the chief of the Conneltown Visitors and Convention Bureau, Mrs. Samantha Hall, chimed in with "Conneltown's growth as a tourism destination is now assured".

That's all very well, but what if the chooks refuse to co-operate? What then?

With all that extra food, toilet paper will achieve a new significance. Environmentally sound versions of the stuff have hit the market and free samples have been landing on the Diary desk at an astonishing rate.

I am the proud owner of a dozen rolls of biodegradable, unbleached toilet paper and, without wanting to sound ungrateful, enough is enough.

The thought has occurred to me that rather than free samples, they may constitute a none-to- subtle form of literary criticism.



Snorkelling off pontoon on Thornton Reef in Hypothetical Bay

Figure 98.1 Editorial article from Mariner City Times

Exercise 99
Ballast water problems

Acknowledgement is given to the Australian Fisheries Management Authority for permission to reproduce the article from Australian Fisheries, October 1992.

Questions

Read the article over and answer the questions below.

1. What is the scientific name for the northern hemisphere starfish?
2. Suggest how this starfish may have been transported to Tasmania.
3. It is stated that '*Astereas amurensi*s' is a voracious species. Explain the meaning of the term 'voracious species'.
4. Predict the effect of this species on the aquaculture, other fisheries and the marine environment.
5. To what group or phylum do the starfish belong?
6. Attempt to define the term 'exotic species' from the way the term is used in the article.
7. Where and when was the first confirmed recording of '*Asterias amuresis*' in Tasmania?
8. How can the species '*Asterias amurensis*' be distinguished from other starfish?
9. The article suggest that governments should spend more money completing base line surveys of material fauna. How would this help in our battle against exotic species?
10. Define the job description of a taxonomist. Why does the article suggest there is a need for more taxonomists?
11. Discuss the biology of the species '*Asterias amurensi*s'. Include its habitat, diet etc.
12. Do you believe that the species '*Asterias amurensis*' will eventually threaten the scallop industries in Queensland.
13. Suggest steps needed to be taken to evaluate the magnitude of the problem.
14. Suggest possible methods to control the population of '*Asterias amurensis*'.
15. Outline the measures governments need to take to stop the introduction of other exotic species.
16. Write a 250 word article on the topic, 'health of Australia's Marine Environment'.

Introduced starfish pose threat to scallops

The recent discovery of a voracious shellfish-eating introduced starfish in Tasmanian waters has aquaculturists and fishermen worried. Wolfgang Zeidler of the South Australian Museum reports on the potential threat of '*Asterias amurensis*' to the fishing industry.

Ballast water suspected

Many foreign species have been introduced to Australian waters since colonisation. In the early days wooden ships were often heavily fouled thus providing the ideal habitat for the transportation of animals and plants. More recently foreign ships have been releasing large amounts of ballast water in Australian ports with recent estimates of around 58 million tonnes being released each year (Jones, 1991). The potential use for the ballast water to carry exotic marine species is well known and the possible harmful effects of these introductions to our marine environment is of particular concern (Hutching et. al., 1987; Jones, 1991).

Obviously not all exotic species transported by ship's ballast survive but some of those that do could have devastating effects on the marine environment and aquaculture. One such potential threat is the recent introduction of a northern hemisphere starfish, *Asterias amurensis* (Lutken, 1871). Just how this species was introduced is not known for certain but, being relatively common in Japanese waters, it was most likely transported to Tasmania in the ballast water of vessels from Japan.

Large species can devour scallops

Asterias amurensis is a voracious species and a well known predator of scallops and other bivalved molluscs in Japan. It's ability to easily prise open and devour scallops is readily demonstrated in an aquarium. Being a relatively large starfish with an arm length of up to 200 mm it is not difficult to imagine the damage a number of these 'monsters' could do to a scallop bed. However, at this stage, the effect of this species on the aquaculture industry, other fisheries and the general marine environment is not known.

A closely related species *Asterias vulgaris* (Verrill, 1866) has been blamed for the demise of the United States oyster industry which was extremely viable early this century.

Distribution and natural history

Asterias amurensis occurs naturally in the northern hemisphere ranging from Kamchatka Peninsula (Bering Sea and Sea of Okhotsk) south to Kyushu (Japan) to about 170 m depth.

In Tasmania I first noticed this starfish in early 1991 as it was common in the dock areas of Hobart and around Sandy Bay.

Believing it to be a Tasmanian species unknown to me, I thought no more of it until a colleague Karen Gowlett-Holmes collected a specimen and concluded it was not an Australian species but an exotic one which was relatively common in Japan.

This identification was later confirmed by Loisette Marsh of the Western Australian Museum who is an expert on starfish and other echinoderms.

The first confirmed record of this species in Tasmania is a specimen in the Tasmanian Museum, collected from Rosny Point, Hobart, in October 1986.

More recently it has been recorded in abundance in the Derwent River around Hobart, ranging from just north of Bowen Bridge to Kingston.

It has also been found on the eastern coast at Triabunna, in Mercury Passage and at Promis Bay (Freycinet Peninsula), in each case associated with scallops, and in the Huon River estuaries with one report of it devouring mussels in a mussel farm at Cygnet!

It was not recorded earlier because the first collected specimen had been mis-identified as a relatively common Australian species, *Uniphora granifera* (Lamarck, 1816) (Figures 1 and 2), which it represents superficially. Likewise other zoologists and naturalists assumed it to be this species and took little interest in it, merely noting that it seemed to have increased in numbers recently. This lapse in detecting the introduced species earlier illustrates the importance of having experts on hand to correctly identify species and monitor the marine environment.

Asterias amurensis is relatively easy to distinguish from other native starfish by its general appearance (Figures 3 and 4) with larger specimens having slightly fatter arms

Fig 1 *Uniphora granifera — dorsal view*

Fig 2 *Uniphora granifera — ventral view*

Fig 3 *Asterias amurensis — dorsal view*

Fig 4 *Asterias amurensis — ventral view*

Figure 99.1 Introduced starfish article (From Australian Fisheries, copyright , October 1992, Reproduced with permission)

(Figure 5). It can be further distinguished from similar Australian species by the four rows of tube feet on the underside of the arms and by the shape of the spines which are not pointed but semi-circular and chisel-shaped. The colour varies considerably from light brown to yellow or orange, often tinted with violet (Figure 6).

According to Fisher (1930) the species can be very prolific and can be found on a variety of substrates ranging from stones and pebbles to 'sticky soft green mud'. Fisher also gives a temperature range of (0.1 – 7.5 ^{o}C) but notes later that the latter might be a few degrees too high! Similarly Hayashi (1973) noted that *A. amurensis* in southern Japan inhabited deeper water than in the north and that: 'in the same region the sea-star seems to be obtained from shallower waters in the winter than in the summer'. He concluded that: 'the vertical and horizontal distribution of the species may be greatly influenced by the temperature of the sea water'. It thus appears that *A. amurensis* is a cold water species.

Just what range in temperature the Tasmanian specimens can tolerate is not known but if they prefer cold waters then the species may be restricted to Tasmania.

Knowledge, monitoring and control

It is most important to first establish the current distribution of *Asterias amurensis* in Tasmanian waters so that the extent of the infestation can be determined. It would also be useful to know the depth range and density of the animals and the temperature of the water they inhabit. The Tasmanian Museum and Art Gallery (TMAG) has produced an informative leaflet to help gather this information. If anyone thinks they have seen this starfish in places other than those mentioned here they should contact the Zoology Department, Tasmanian Museum, 40 Macquarie St, Hobart 7000, preferably with a specimen so that the identity can be confirmed.

The TMAG through this information leaflet and general publicity has alerted the Tasmanian fishing and aquaculture community to this potential threat and is extending its message to the mainland community. The possibility that the starfish may occur in mainland waters cannot be overlooked, particularly in colder waters.

Regardless of what, if any, control methods are adopted, it will be necessary to regularly monitor selected populations of this starfish to ensure that it does not become a threat to the marine environment and hence the fishing industry.

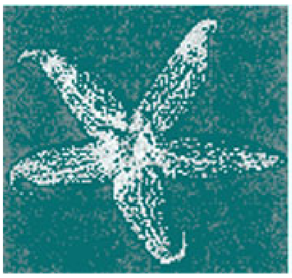


Fig 5 *Asterias amurensis*

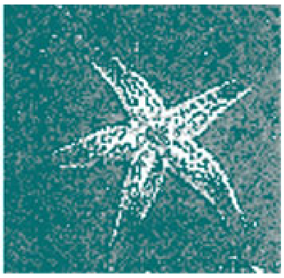


Fig 6 *Asterias amurensis*

A concern for governments

The introduction of exotic species to Australian waters should be of particular concern to federal and State Governments and the fishing industry. It highlights the following.

- The need for stricter controls on the release of ship's ballast water and other means of passage for exotic species.
- The need for base-line surveys to determine the natural fauna of an area so that the effect of introductions can be determined. This would also identify any introduced species that have not yet been recorded.
- The need to monitor the health of our marine environment by regular follow-up surveys. This sort of data is essential to identify introductions at an early stage and determine the impact of exotic species; it may also alert authorities to other factors effecting the health of the environment such as pollution.
- We have any number of pest control officers employed by various authorities for the terrestrial environment, why not also for the marine environment which is as large or larger and every bit as valuable?
- The need for taxonomists so that species can be quickly and accurately identified. The need for a correct identification becomes immediately obvious when one considers that the scientific name enables the researcher to locate all the literature concerning that species.

A wrong identification of a potential pest will lead to a different data set resulting in control methods which may be inappropriate and could cost millions to rectify. Contrary to popular belief, much of Australia's marine fauna is undescribed and probably new to science, thus compounding the problem of distinguishing native and exotic species. Unfortunately the number of practising taxonomists in Australia and worldwide is declining. Even worse, it is not something that can be rectified quickly as it takes several years to develop the expertise in just one group of animals to enable quick and accurate identifications.

Wolfgang Zeidler is Senior Curator, Marine Invertebrates, at the South Australian Museum.

References

References for this article can be obtained from AFMA PO, Box 7051, Canberra Mail Centre 2610. Please quote Australian Fisheries, October 1992.

Figure 99.2 Introduced starfish article cont'd. (From Australian Fisheries, copyright, October 1992, Reproduced with permission)

Exercise 100 Positive and negative effects

Based on an original exercise by Tim Ryan.

Method

This activity is designed to develop the skill of verbal communication. It develops skills in public speaking and helps you to become more articulate in arguments. You may also become more confident.

Study the house rules of debate in Figure 100.1 and pick class teams to debate the following issues.

1. That exploration for oil and gas in offshore Australia should go ahead.
2. That whaling should be banned completely.
3. That Japanese fishermen should be given fishing rights in Australian waters.
4. That commercial fishermen are destroying our fisheries.
5. That technology has improved our standard of living.
6. That sewage should be pumped into the sea.
7. That shark netting should continue.

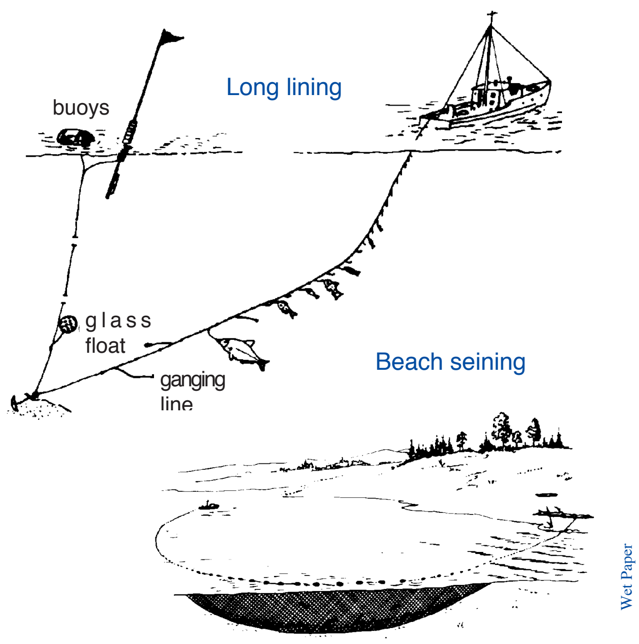


Figure 100.2 Some commercial fishing methods

Introduction	-	the chairperson introduces the topic and the speakers
First affirmative	-	the speaker defines the topic and the affirmative case
First negative	-	defines the topic, attacks the arguments of the first affirmative speaker and outlines the negative's case
Second affirmative	-	attacks arguments of the first negative speaker and presents the main part of the team's case
Second negative	-	attacks arguments of the second affirmative speaker and presents the main part if the team's case
Third affirmative	-	attacks the negative case and summarises the team's case
Third negative	-	attacks the affirmative case and summarise the teams case
Adjudication	-	the Adjudicator chooses the team who presented the most effective case and provides a rational for the choice

Wet Paper

Figure 100.1 House rules of debate

Exercise 101 Starfish pest study in Hypothetical Bay

Based on an original exercise by Tim Ryan, Maryborough State High School

Questions

Read the article in Figure 101.1 and answer the following questions.

1. Define the term 'biological control'.
2. Explain why Dr. Morrison has bred thousands of baby crowns of thorns starfish.
3. What do crown of thorns starfish eat?
4. Suggest why the starfish will be artificially introduced onto the reef when many areas of the reef have established populations.
5. Who is in charge of the management of the marine park?
6. A project to monitor the health of Thornton Reef has recently started. What effects will it monitor?
7. Suggest some predators that may be used to control the crown of thorns starfish.
8. Explain why the biological control needs to be approached with extreme caution.
9. Outline some cases where biological control has been a success.
10. Give an example of a biological control gone wrong.

STARFISH PEST UNDER SCRUTINY IN HYPOTHETICAL BAY

Wet Paper

Students from Mariner City Senior High School assist Dr. Morrison with starfish research last week

Thousands of coral eating crown of thorns starfish are to be released on Thornton Reef in a controversial experiment that could see biological controls used on Hypothetical Bays's marine wonderland for the first time.

Scientists at the Mariner City Institute of Marine Science (MCIMS) will study the survival rate of different baby starfish colonies when the unique project starts next month.

If predators emerge with an unusually healthy appetite for the prolific pests, they could be artificially introduced to different areas of the reef.

"It's something we've thought about, but that decision would not be taken by us," said Dr. Peter Morrison, who has bred thousands of baby crown of thorns starfish in special salt water tanks.

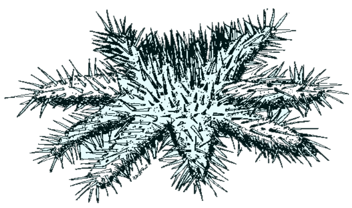
"If we find there is an animal which feeds on the starfish at a rate sufficient to control population density, it would be up to the management of the marine park to decide whether they should be introduced elsewhere on the reef."

Dr. Morrison has just returned from an international coral reef symposium in Guam where scientists expressed major concerns about the health of the world’s coral outcrops.

A project to monitor the health of Thornton reef has recently started, which will carefully scrutinise the effects of pesticides, fertilisers and human intrusion.

Dr. Morrison said Project Starfish was part of a major effort to get a daily profile of the reef.

But he warned that introducing biological controls on the reef would have to be approached with extreme caution.



A crown of thorns starfish

Wet Paper

Figure 101.1 Article on starfish experiments (Article reproduced courtesy Mariner Times)

Exercise 102
Marpol

Questions

Search the internet for photos and articles on sea pollution and answer the questions below.

Protecting our seas

1. Look at the photos. Describe what you see.
2. Which is the major form of pollution: oil, garbage, chemicals or sewage?
3. What does the term 'innocent passage' refer to?
4. What is MARPOL and what other related international conventions has Australia adopted to protect our seas?

MARPOL 73/78

1. List the five annexes to MARPOL 73/78 and draw up a table to show what each deals with.
2. Draw up a diagram like the one shown in Figure 102.3 marking in where disposal at sea is prohibited and colour in the diagram for effect.

   Explain the reasons why you think these areas have been selected.

For further investigation

1. Use reference books to find out which annexes of MARPOL are yet to come into force?
2. What local council bylaws are in place to protect the seas in your local area?

Materials required

Copy of the brochures — *Protecting our Seas* and *Stow it don't throw it*.

Available from:
www.amsa.gov.au

AMSA
Australian Maritime
Safety Authority

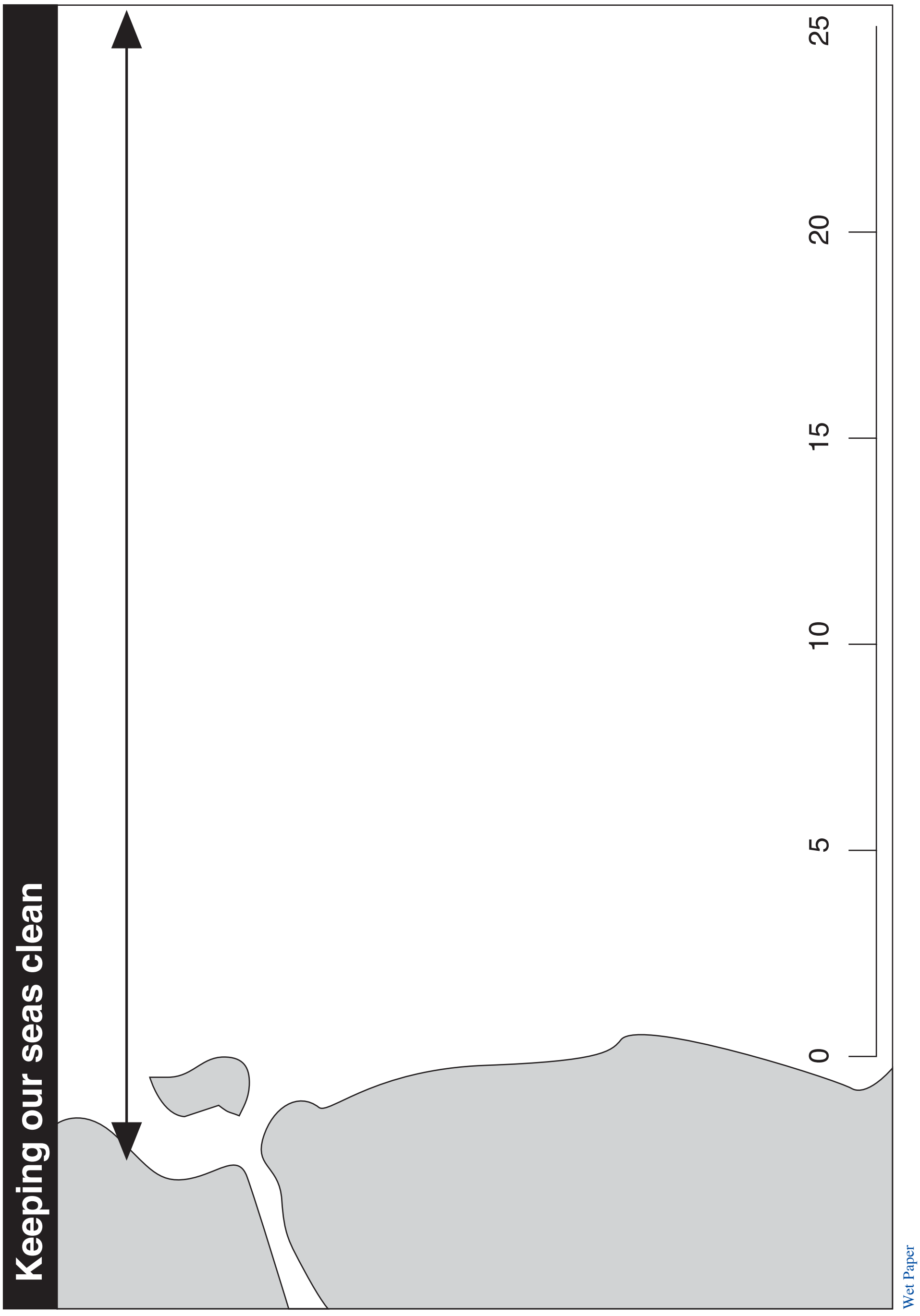


Figure 102.3 Outline of diagram on keeping our seas clean

EXERCISE 103
MASTER
MARINERS STORY

QUESTIONS

Read the story in Figure 103.1 and answer the following questions,

1. Use a map to locate the places mentioned in the article and mark out a possible passage for the ship on Figure 103.3.
2. Turn to activity 102 and find out how far the ship must have been offshore when the master summoned her crew.
3. How are hay bales stored on a ship?
4. Suggest possible reasons for the sheep being transported.
5. Do you think the master gave correct instructions? If you were in the same shoes, would you do any differently. Give reasons for your answer.
6. The ship's master gave instructions for other materials to be disposed of. What were they and why should they be disposed of in this way?
7. The story does not tell what was done with the wheelie bins. What would you do and give reasons for your answer.

Extension Activities

1. Students invite a master mariner to talk to class about life aboard a ship and the ways in which the shipping industry helps to prevent pollution of the seas.
2. Find out what has to be declared at port in terms of rubbish.
3. How many ships actually declare rubbish to be collected?
4. Does your port operate a user pays system for rubbish collection?

   Is this a wise practice or should a conservation group offer to collect a ship's rubbish for them.
5. How would set up an environmentally friendly port to encourage ships to 'do the right thing'?

Invitation

Why not show this page to your local Master Mariners Association to see if they have any similar stories that they would like to come to class to tell?

Morning tea is always a nice time to tell stories.

I was invited to address the Master Mariners Association recently and after dinner was treated to a really great story that I would like to share with you all.

A master mariner was give charge of a ship to take some sheep to Brunei from Western Australia as shown in Figure 103.2.

The ship was loaded in Fremantle and the crew — a multinational group from Papua New Guinea, Irian Jaya, Java, Sumatra and India, set about their normal jobs of loading and securing the feed and safety checks prior to departure.

The sheep were loaded and the ship steamed off into the Timor sea. It was on the first day that the ship's master watched in horror as the plastic strapping that held the hay bails was unclipped and thrown overboard. Worse still the crates on which the hay was stacked were also turfed over the side.

The ship's first mate was summoned and the crew paraded on desk to an angry ship's master.

"Which one of you has $25,000?" quizzed the master. "Well, come on, speak up - because that's the fine under Marpol for throwing plastic overboard."

Well, the crew were sullen faced and it was a while before the first mate inquired what should be done.

The master gave instructions for the remaining plastic strapping that held the hay in place to be stuffed into bags and the wooden crates neatly secured on deck out of the way. All other rubbish was to go into wheelie bins and separated out – glass, cans, paper, plastic, with food scraps to be disposed of over the side once a day, upon his inspection. Nothing else was to be thrown overboard.

Upon arrival at Bandar Seri Regawan, capital of Brunei, the first mate asked what was to be done.

The master instructed that the wooden crates, be neatly stacked on the wharf and that the bags containing the plastic strapping be placed neatly beside them.

Within half an hour a truck came from nowhere and took away the wooden crates and that afternoon, the strapping was seen to be woven into roof thatching by workers in the town. Indeed one person's trash is another person's treasure.

Figure 103.1 A ship's tale (The author wishes to thank Norman Lopez for inviting him to dinner and the ship's master present for relating the story)

Figure 103.2 The sheep ship being loaded in Fremantle

Figure 103.3 Mark the route as told in the story. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 104
At the fish shop

Research project

In this activity you are to make up a report on the current cost of local and imported seafood. Because not all seafood is caught locally, the fish shop will bring in fish from other parts of your state, interstate or even overseas.

Use the following suggestions to complete a report on your local fish shop. This could be a group project with one person actually going to the shop and collecting the data with the others analysing the data or following up leads given by the shop owner.

If there are a number of shops in town, you may like to split up and compare results.

1. Make a list of all the seafood products sold and the price per kg. Make sure you tell the owner that you are doing this as a research project for school.

2. Make a time that is convenient to the shop owner (try to avoid lunch times or weekends when the owners are flat out trying to make a quid) and match the products that are sold with the places they come from.

3. Find out how the products are transported and stored at the shop.

   Use the map opposite to mark where the fish come from.

4. Ask the owners to list the most popular sales and the quantities they order and to tell you any problems they have with supply.

5. Collect any other information your group may feel relevant.

Figure 104.1 At the fishshop

Figure 104.2 Mark in where seafood comes from. Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet

Exercise 105
Prawn fishery economics

Based on an original activity by Gwen Connolly and John Maloney.

Acknowledgement is given to the Australian Fisheries Management Authority for permission to reproduce Figures 105.1 - 105.6 and the 1991 statistics provided by the Australian Fisheries Service.

Questions

Study the information in Figures 105.1 to 105.6 and answer the following questions.

1. What is the preliminary catch? What factors in the Banana Prawn Fishery make this a reasonable measure of the likely total catch?
2. Rank the 18 areas of the N.P.F. in terms of their 'effort' (days) from greatest to least.
3. For each area, calculate 'the efficiency of production i.e. Kg/day.'
4. Why is this efficiency index not always a good/accurate measure of Banana Prawn production?
5. Rank the 18 areas against their efficiency from greatest to least.
6. Compare the rank of 2 and explain any 'trends' in productivity.
7. Calculate the average tonnes/boat. What percentage of boats caught more than the average tonnes/boat?
8. Find out the current price for each of the prawn species mentioned and calculate the economic value to the fishery.

Research

1. Find out what the Northern Fishery is worth today.
2. How do present day figures compare with those outlined in this activity. Suggest possible reasons for differences.

   For up to date information you can write to:
   Australian Fish Management Authority
   PO Box 7051
   Canberra Mail Centre ACT 2610

Northern Prawn Fishery

1991 Preliminary banana prawn statistics

Just over 6 000 tonnes of banana prawns were caught in the Northern Prawn Fishery in the first half of the 1991 season. This total came from logbook returns provided by 167 boats which fished the area from Cape Londonderry in Western Australia to Cape York in Queensland.

The banana prawn catch was 21 percent higher than the 1989 preliminary catch of 4 827 tonnes.

The higher catch followed the heavy falls of monsoonal rain in northern Australia earlier this year and confirmed the early predictions of a high catch of banana prawns.

About 66 percent of the banana prawns were caught in the eastern side of the Gulf of Carpentaria – an increase of 24 percent from last year. The largest catch of 2 018 tonnes was taken from the Bold statistical region and not from the usual largest catch region off Weipa, which came in second with 942 tonnes. Collier Bay recorded the lowest catch of 9 tonnes.

The distribution of banana catch by boat shows that 74 percent of the fleet caught 50 tonnes or less of banana prawns with the remaining 26 percent catching over 50 tonnes.

More than 2 200 days were spent fishing in Mornington. There were 1 300 days fished in Bold with Bonaparte, Melville and Weipa also recording high effort.

Should you have any comment or further enquiries, please do not hesitate to contact any of the logbook team.

Logbook Co-ordinators

Jo Kovacevic (Canberra) , Margot Sachse (Darwin), Butch/Bev (Cairns).

Figure 105.1 Information on Fishery (From Australian Fisheries Service Statistics, 1991)

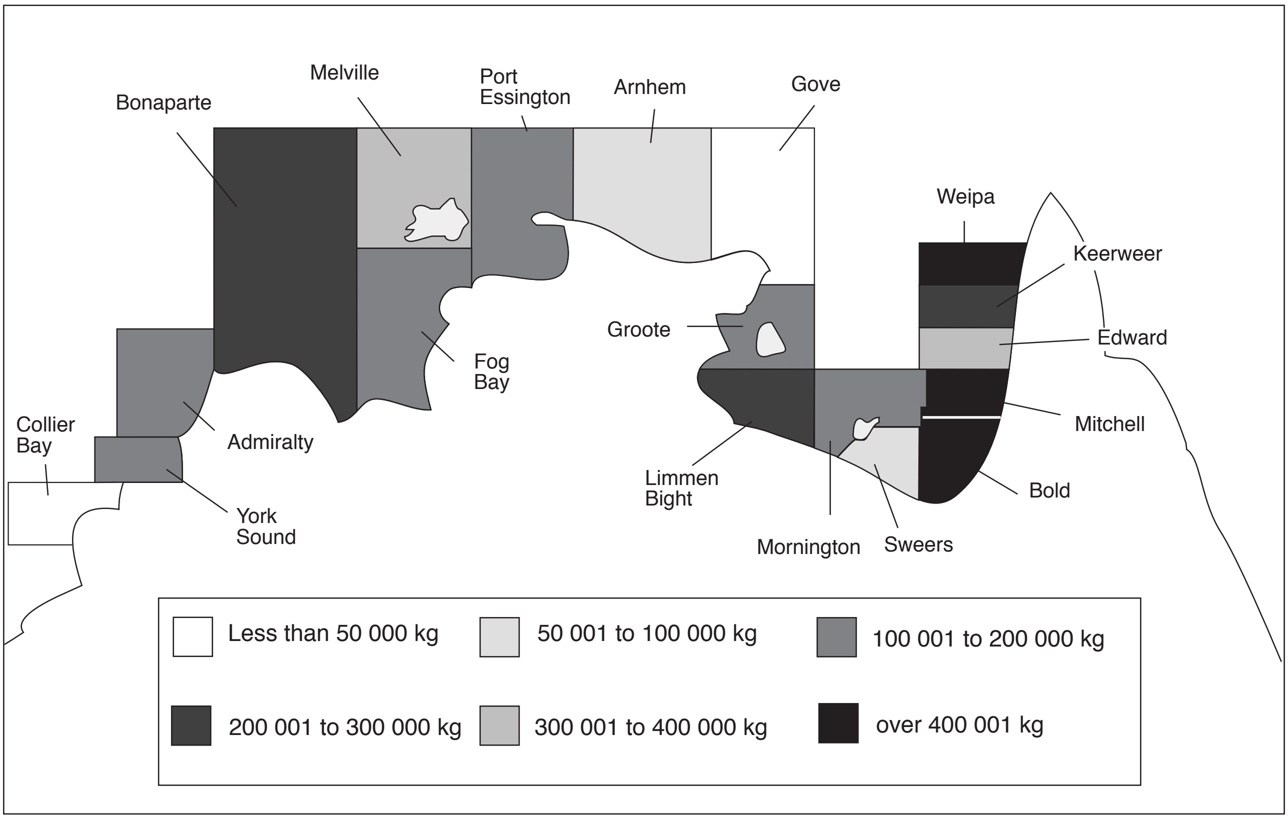


Figure 105.2 1991 Banana prawn catch in the Northern Prawn Fishery
Wet Paper

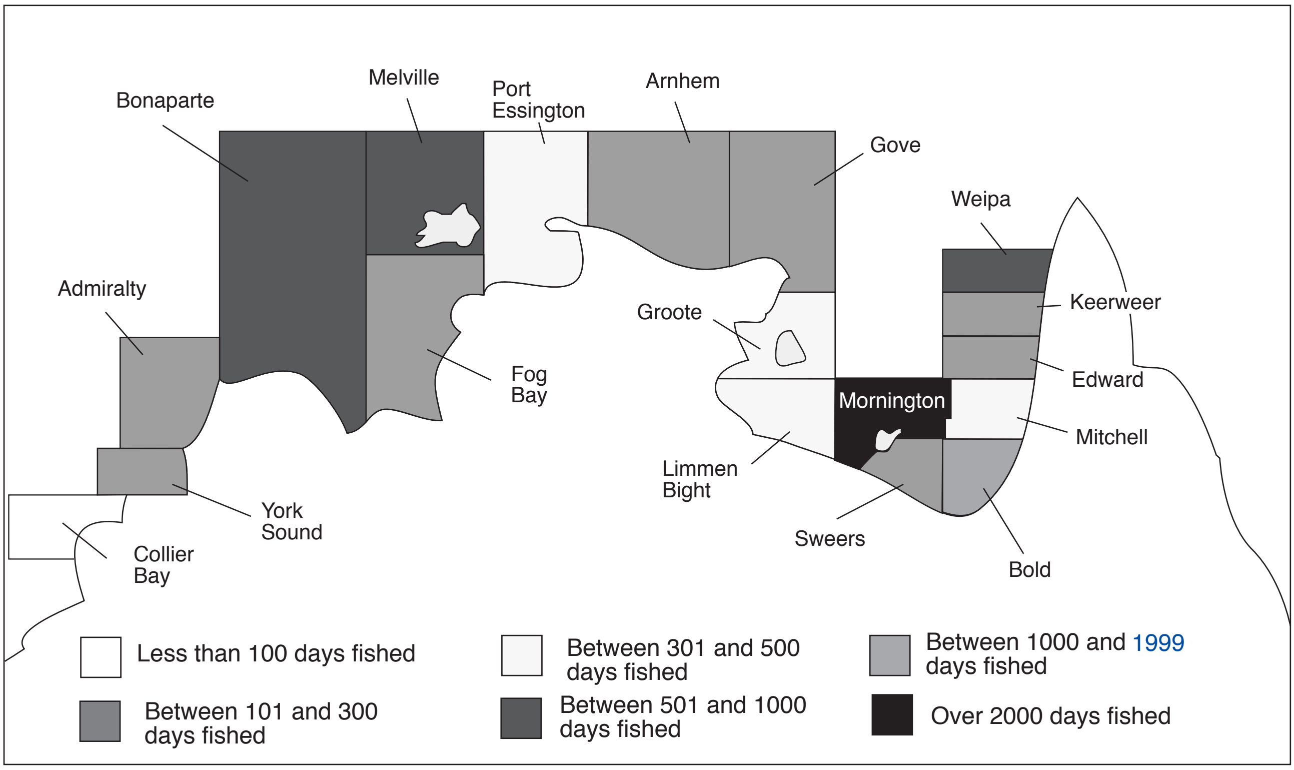


Figure 105.3 1991 Banana prawn effort in the Northern Prawn Fishery

Wet Paper

Area	Effort (days)	CPUE (Kg/day)	Effort (hours)	Banana (Kg)	Total (Kg)
Admiralty	292	615	4921	161798	179669
Arnhem	271	305	4279	70725	82716
Bold	1300	1597	21251	2018318	2076100
Bonaparte	663	444	13189	285523	294268
Collier Bay	13	692	247	8690	8990
Edward	279	1388	5041	387344	387357
Fog Bay	287	574	4795	164643	164721
Gove	139	242	2528	32898	33624
Groote	359	549	4885	170487	197253
Keerweer	245	943	4429	230950	231146
Limmen Bight	321	864	5504	267494	277467
Melville	863	477	16039	347624	411506
Mitchell	351	1175	6470	412255	412255
Mornington	2223	263	27646	116837	583975
Port Essington	424	573	7834	222322	242968
Sweers	246	438	4291	96229	107687
Weipa	655	1448	9469	942495	948459
York Sound	158	880	3319	124284	139065
Unspecified areas	43	588	825	25105	25272
Total	9132	745	146962	6086021	6804198

Figure 105.4 1991 Banana prawn data catch and effort by region

Wet Paper

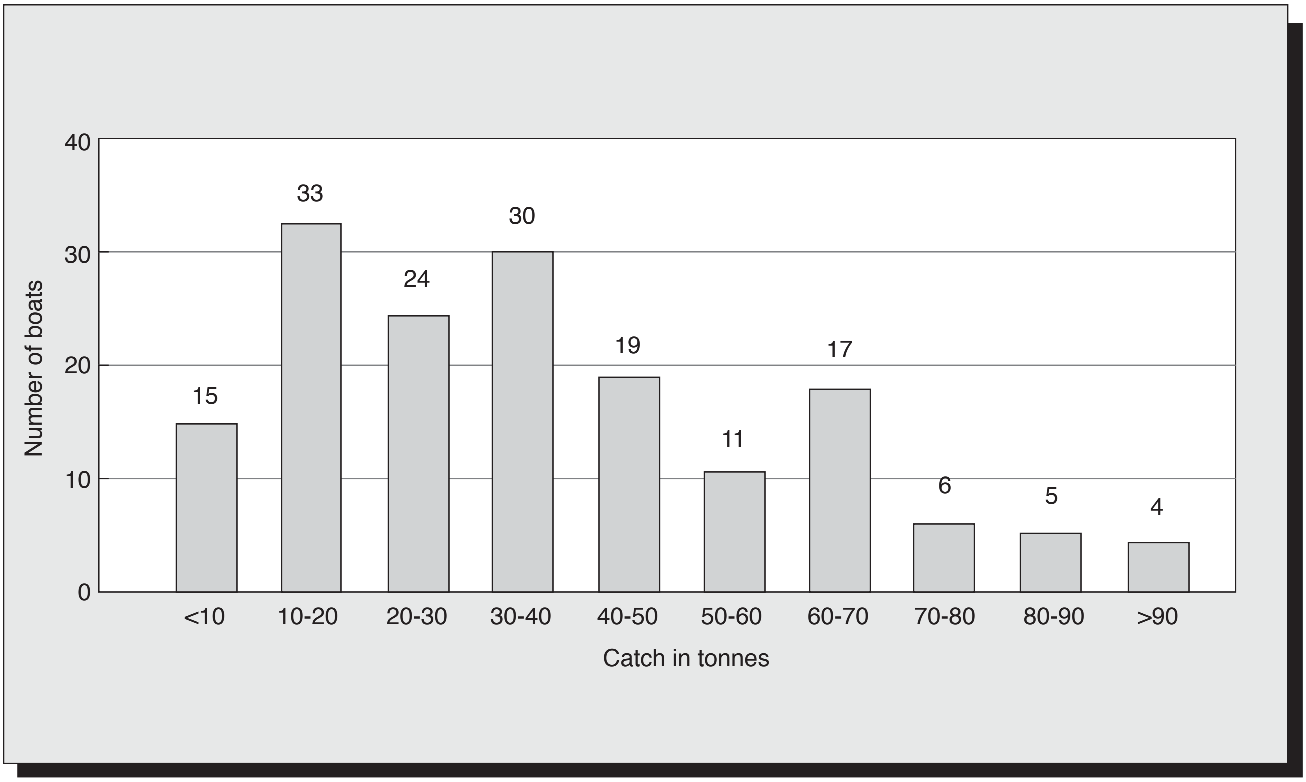


Figure 105.5 1991 Banana prawn distribution by boat
Wet Paper

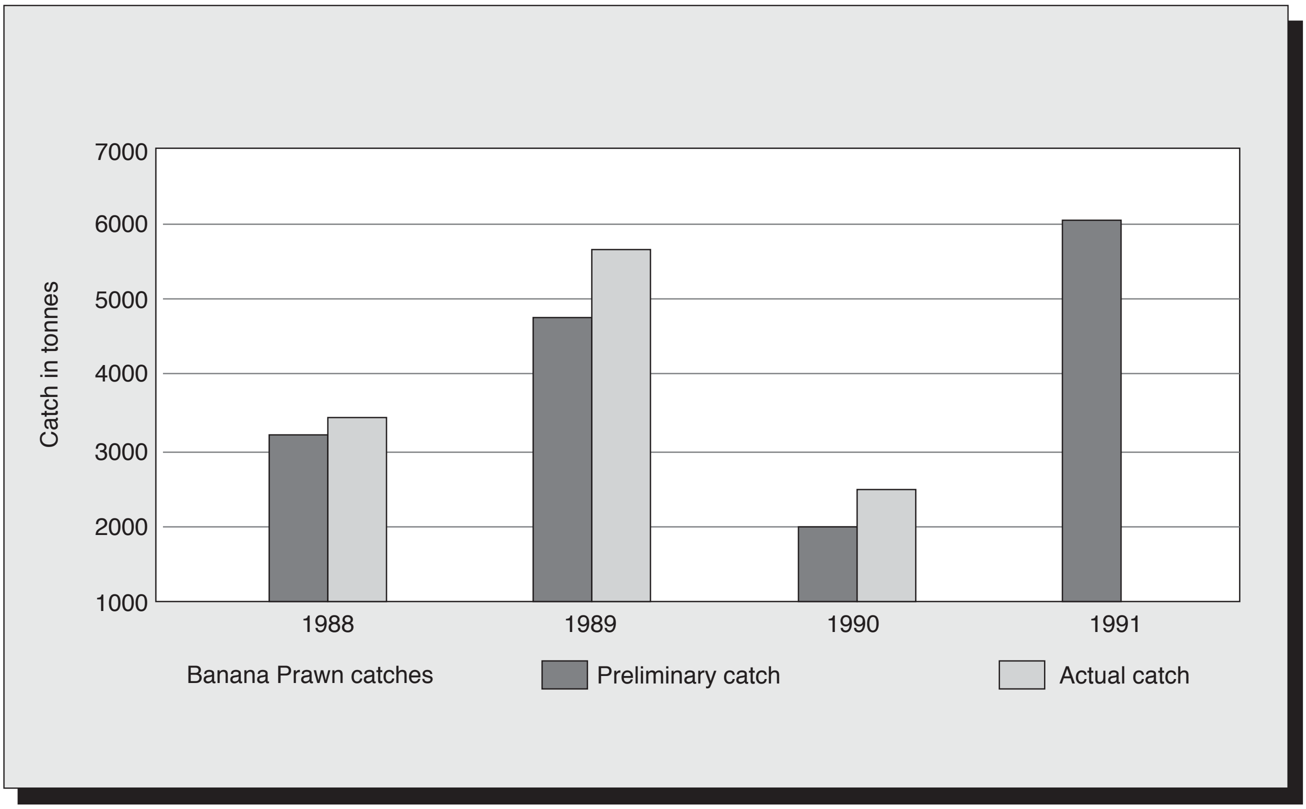


Figure 105.6 1991 Banana prawn catches over the past three years
Wet Paper

EXERCISE 106 THE ORANGE ROUGHY

Based on an original activity by Tim Ryan, Maryborough State High School. Acknowledgement is made to the Australian Fisheries Service for providing the permission to reproduce the article in Figures 106.2 and 106.3.

QUESTIONS

Read the article in Figures 106.1 and 106.2 and answer the following questions.

1. Why is the ageing of deepsea and tropical fish not possible by the common method of counting growth rings on scales or otoliths?
2. Explain the radioactive method which was developed to solve the problem of the ageing to orange roughy.
3. The natural levels of which radioactive element were involved in the investigation?
4. If a radioactive compound has a half life of 120 years, calculate the age of a sample if only 0.125 g of an original 1 gram sample has not decayed.
5. Graph the results shown in Table 1 Figure 106.2 comparing the mean fish length to the calculated age.
6. At what age is growth rate greatest for the orange roughy?
7. a. Explain the following result: 39.30 cm fish had an age of 127 years while a 40.30 cm fish was only 94 years.

   b. Does this mean this technique should not be used because of these irregular results?
8. If a 50 cm length fish having a mean otolith mass of 400 g and a 210pb/225 Ra activity ratio of 0.9 was found calculate the age of the specimen.
9. Calculate the half life of 210 lead.
10. What important implications do the results of the radiometric analysis which showed slow growth rates and longevity of orange roughy have for the sustainability of the fishery?
11. What measure might you recommend to sustain this fishery?

Figure 106.1 An orange roughy (Photo by Geoff Jensen)

Orange Roughy

From Australian Fisheries, January 1992, Reproduced with permission

Their age unlocked by radioisotopes

Who would suspect that the delicious, white flesh of orange roughy reaching our tables was from fish born before World War Two or even before the turn of the century? Difficulty with traditional methods of fish ageing led scientists from the Zoology Department of the University of Tasmania and the Environmental Radiochemistry Laboratory (ANSTO) to apply a radionuclide approach to reveal the age of orange roughy (Figure 106.1). Gwen Fenton, Steve Short and David Ritz report.

Orange Roughy *Hoplostethus atlanticus* is currently the primary target species in the south east trawl fishery. It is a deepsea species with large commercial catches being taken in the 900 - 1100 metre depth zone. How quickly orange roughy grows, what age it matures and how long it lives are basic questions that scientists need to answer for management of the fishery. But answering these questions is not always easy.

Traditionally, two main methods of ageing have been used for fish. Firstly, examining changes in the population structure over several months or years often reveals the progression of strong year classes. The rate of progress of these year classes gives a measure of the fish growth-rate but this method generally only applies to the period of maximum growth, for example juveniles. However, it is not always possible to identify and follow year-classes, especially for fish that are long-lived.

The second common approach is the counting of growth rings (daily or annular) present on fish scales or preferably otoliths (ear bones) to give the age (see Fig 1). However, this has not always been attempted or possible due to indistinct rings (e.g. deepsea and tropical fish species where strong seasonal cues are not experienced). Age estimates made without this data can be grossly inaccurate.

Orange roughy has proven very difficult to age using these traditional methods. Attempts to follow year classes in orange roughy populations have failed, except for small juveniles (Mace et. al., 1990). In addition, attempts to count rings on the otoliths have produced mixed results, ranging from statements that ages cannot be determined using the rings, to age being estimated but with varied result, for example 5-12 years for fish to mature (Fenton et. al., 1991).

The rings present on the surface of otoliths have only recently been correlated with time, but only for juveniles under three years old (Mace et. al., 1990). Their results indicated growth was very slow for juveniles and therefore age of adults was speculated to reach around 50 years.

However, none of the commonly used methods of ageing have been able to determine the age of adult fish. Therefore a different approach was needed. A radiometric method was developed and applied to try and solve the question of age for orange roughy.

Radiometric method

The naturally occurring levels of a wide range of radioactive elements provide a very convenient and accurate means of dating or ageing, for example carbon-dating uses the natural levels of carbon-14. Each radioactive element decays or disintegrates at a fixed rate and by using this rate it is possible to calculate how long ago the element was taken up. For fish, isotopes with decay rates in the order of years are needed for calculating their age.

The method used for orange roughy involved measuring the natural levels of the radioactive elements radium-226 and lead-210 present in the otolith of the fish. Radium-226 decays (at a known rate) into another radioactive isotope, lead-210. After about 120 years the production of lead-210 (from the decay of radium-226) equals the loss of lead-210 by decay.

By measuring the degree of the disequilibrium, the age can be determined. Since otoliths continue to grow throughout the life of a fish, and therefore new radium-226 is constantly being added to the otolith, the growth pattern of the otolith is incorporated in the calculation of the fish age.

One gram of otolith material was required for each sample. This involved using the otoliths of several fish for all but the largest individual. All adults analysed were female. The analytical technique started with thorough cleaning of the otoliths which were then dissolved in acid and radioisotopes separated and

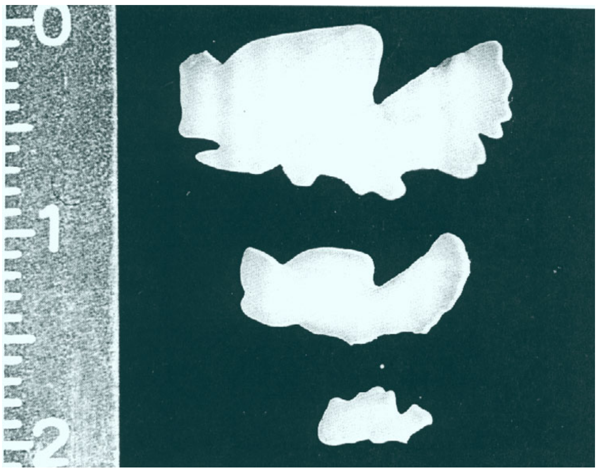


Fig 1 Otoliths

Figure 106.2 Article from Australian Fisheries, January 1992 extracted. Radium-226 and lead-210 concentrations were then measured separately by low-level alpha-spectroscopy.

The counting required the most sensitive instruments available to detect the extremely low levels of radiation present. Counting times were typically 2-3 weeks. The age was then calculated.

Results of study

Otoliths from fish ranging from 10 cm standard length (SL) to 40 cm SL were analysed (Table 1). Age has been calculated using an equation which models the mass growth of the otolith (discussed in detail in Fenton et. al., 1991). The equation assumes a decrease in the growth rate after the fish reaches maturity; that is a two-stage growth model.

We found orange roughy to be a very slow growing and long-lived species with fish 38-40 cm SL ranging between 77 and 149 years old (Fenton et. al., 1991). Our results also indicated that maturity is around 32 years which occurs at about 32 cm SL (Lyle et. al, 1989).

It is also interesting to note that orange roughy which are greater than 50 cm SL may represent faster growing members of the population or alternatively they may be extremely old. Until otoliths from these large individuals are analysed their age will remain a mystery.

Our results show that orange roughy is one of the longest-living fish species known. However, there are several other fish species also known to reach in excess of 70 years and a few species, e.g. *Sebastes borealis* and *S. aleutains* have been reported to reach 120 and 140 years respectively (Beamish and McFarlane 1987).

In conclusion, the radiometric technique has proved very valuable to sort out the problem of ageing orange roughy (the technique is also suitable to age other fish species, molluscs, echinoderms and corals).

Fig 2 Catching the orange roughy

The slow growth rate and longevity of orange roughy, revealed by radiometric analysis, have important implications for the sustainability of the fishery.

Gwen Fenton is a Research Fellow and David Ritz a Senior Lecturer, in the Zoology Department, University of Tasmania. Steve Short is Manager of the Environmental Radiochemistry Laboratory, Australian Nuclear Science and Technology Organisation.

Radiometric age determination of orange roughy otoliths*

Mean fish length	No. of otoliths	Mean otolith mass (mg)	^{210}Pb/ ^{226}Ra actvity ratio	Otolith age (years)
10.87	135	7.6	0.063±0.061	0.9±0.9
14.20	102	13.9	0.134±0.045	6.1+3.6, -3
16.51	54	21.0	0.193±0.097	10.7+8.9,-7.6
25.40	16	66.1	0.333±0.067	23.4+8.9,-6.9
33.90	8	137.9	0.427±0.093	36+14,-11
37.30	6	175.1	0.499±0.065	47±5
38.90	4	241.2	0.755±0.202	92±24
39.05	4	185.3	0.814±0.132	77±12
39.20	4	270.6	0.867±0.085	118 ± 11
39.30	4	338.8	0.746±0.068	127±11
40.30	2	224.0	0.830±0.163	94±18
40.40	4	367.5	0.806±0.069	149±12

* All errors expressed at the ±1 SD.

Table 1

Figure 106.3 Article from Australian Fisheries, January 1992

Exercise 107
Adopt a ship

Based on an original activity by Geoff Jensen, Innisfail SHS

Class activity

1. Contact your local harbour master or master mariners' association to see if they can recommend a ship the school can adopt.
2. When you make contact, send a copy of the school flag and ask the master to send some details about the ship, where it is going and what cargo it is carrying.
3. Make up a wall chart and enlarge the illustration below on the school photocopier to follow the ship's progress around the world.
4. Calculate times and distances and see if you can get information on nautical miles and passage plans (if possible). Find out which ports have waste disposal facilities and what every day problems the ship's master has with new pollution regulations.
5. Invite the ship's company to a school BBQ or morning tea as a public relations exercise.

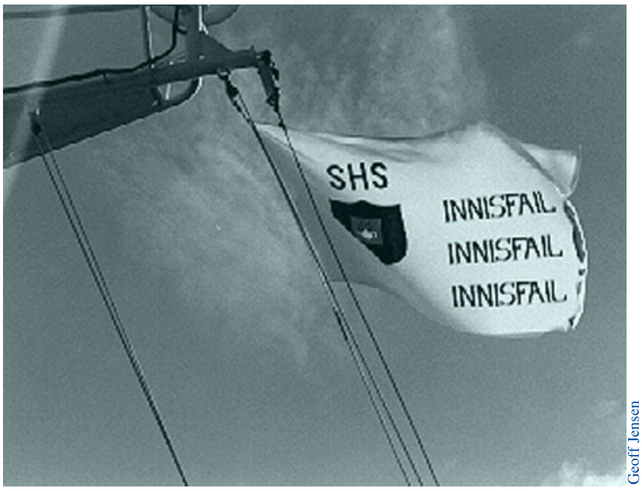


Figure 107.1 The school flag goes around the world with the ship

Figure 107.2 Mark on your map where your ship goes. Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet

Exercise 108 Commercial fishing game

Based on an original exercise by Tim Ryan, Maryborough State High School.

Method

Make a copy of Figure 108.1 and paste it down onto some stiff cardboard.

You are to develop a board game which would give the players an insight into the problems faced by commercial fishermen. Here are some suggestions.

1. Develop a list of factors which may affect the efficiency of a commercial fishing venture.
2. Analyse each factor and evaluate it's effect on the operation.
3. Prepare 20 captions to be written in the form of a factor and its ensuing effect. For example:
   - Cyclone in area, return to harbour. Go back 3 spaces.
   - Fishing nets need repair. Miss a turn.
   - Fishing import banned. Increased prices. Advance 5 spaces.
4. Label a box at one end 'Start' and one at the end 'Finish'.
5. Write your captions in the different boxes.
6. Illustrate the game with pictures or diagrams of the fishing industry.
7. After accessing and utilising the data, prepare a report on the health of the commercial fishing industry.

Materials and equipment (per group)

Equipment required

- chart paper
- information booklets such as Queensland Fish Management Authority 'East Coast Trawl Fishery situation' paper
- dice
- coloured marker / counters

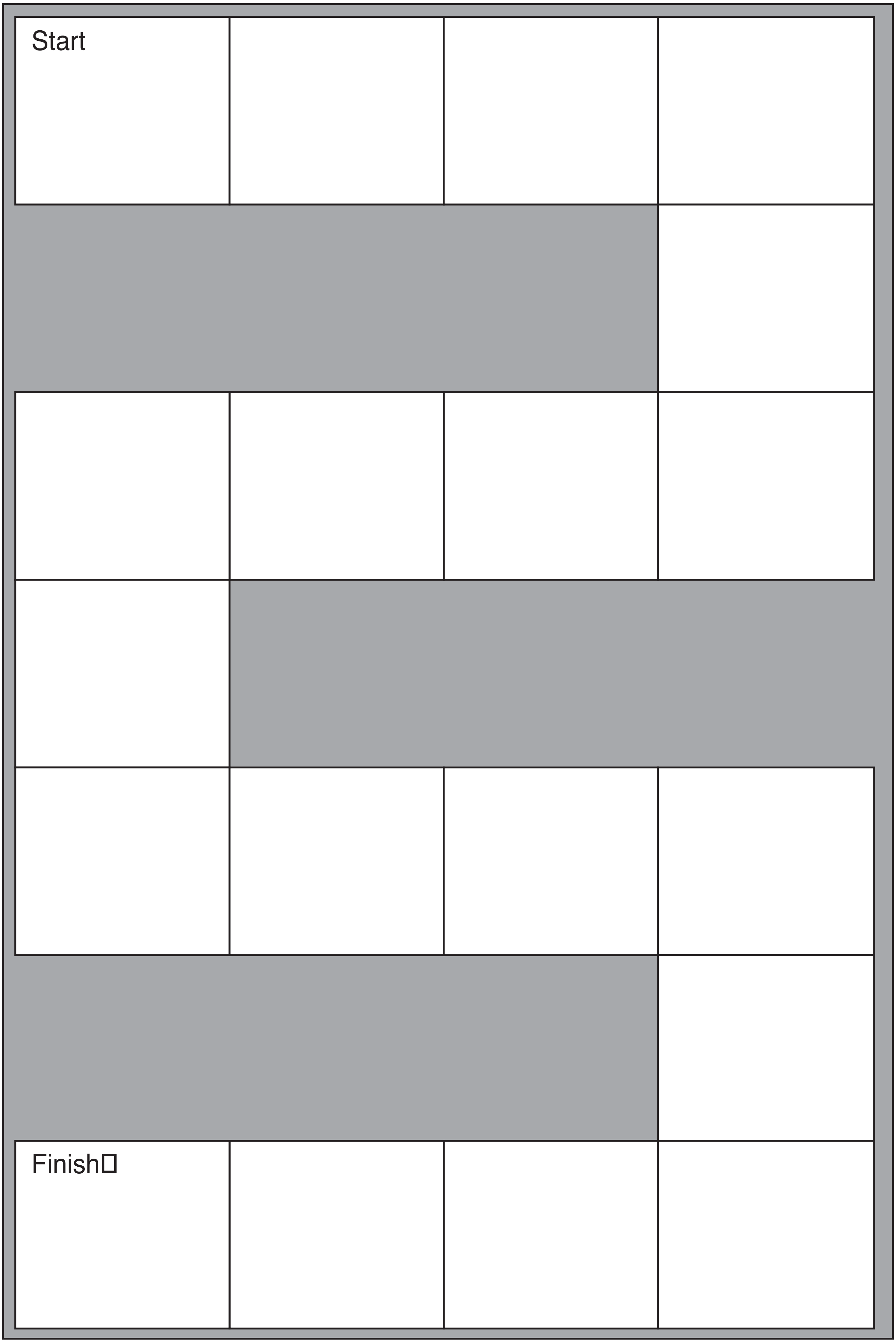


Figure 108.1 Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet

EXERCISE 109
WHAT TYPE OF FARM FOR ME?

Based on an original exercise by Tim Ryan, Maryborough State High School.

QUESTIONS

For questions 1 - 5, use table 109.2 which shows some comparison of production and yield of some species used in aquaculture.

These are predicted values and are, by no means, exact figures as costs of production are controlled by a number of factors which vary from time to time and place to place. The market values will also depend on the production in that area.

1. Calculate the yield per hectare for each of the species. Divide the value in column B by the value in column A.
2. How much would it cost to operate each of the following farms if each farm was to produce 10 000 kgs of produce per year.
   a. murray cod
   b. marron
   c. oyster
   d. seaweed
3. Calculate the profit for one year for each of the farms discussed in Question 2, using the expected sale price shown in the table.
4. What percentage of the cost is the food bill for the fish?
5. Which of the farms has the greatest production cost per hectare?
6. What is the major factor involved in the running of a fish farm?
7. Which of the farms listed in the table showed the greatest profit margin?
8. What costs would be involved in the advertising expenses for this farm?
9. In which areas could you become more cost efficient?
10. Farmers are, today, having difficulties in feeding the world's population. Which of these farms has the greatest potential to solve these problems? State your reasons.
11. The farming of domesticated animals presents many problems to the farmer. List some of the problems the farmer faces. Could these same problems occur in aquaculture?
12. What could be some of the advantages and disadvantages of a mariculture farm based in an estuary or open sea compared with a freshwater farm (Figure 109.1)?
13. How could the production in the ponds or enclosures be increased? List three ways of increasing production.
14. Discuss some of the reasons that may force an aquaculture venture to fail.

Tim Ryan

Figure 109.1 A freshwater fish farm

Species	A Pond size (ha)	B Total annual yield (kg)	C Production cost cents/kg	D Expected sales price c/kg
Freshwater				
Murray Cod	40	72000	80	600
Golden Perch	40	80080	80	400
Catfish	4	31000	80	250
Marron	8	21000	90	800
Estuarine				
Barramundi	40	45000	120	700
Mud crab	60	47000	140	1000
Marine				
Prawns	30	84000	350	500
Mussel	40	120000	100	200
Oysters	40	90000	120	600
Seaweed	20	600000	10	20

Wet Paper

Figure 109.2 Information for questions 1 - 5

Estimated running costs for a particular fish farm

	Cost/ha $		*Cost/ha $*
Fingerlings	200	Harvesting	100
Food	500	Electricity	30
Fertilisers	100	Depreciation	30
Pesticides	120		
Buildings	400	**TOTAL**	**$1600**
Advertising	20		
Labour	100		

Wet Paper

Figure 109.3 Information for questions 6 - 14

Exercise 110 Aquaculture research

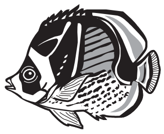
Research questions

Use your school library and evidence from previous class experiments to answer the following research questions.

1. What are some factors to consider when selecting an aquaculture species?
2. Why will aquaculture become more important in the future?
3. Why is so much importance placed on cleanliness in the hatchery.
4. What conditions are necessary to get barramundi to spawn:
   a. naturally?
   b. in the hatchery?
5. What are the causes of a failed hatch?
6. What food is fed to fingerlings?
7. What are rotifers - Phylum family?
8. What is the difference between a hatchery and a grow out area?
9. Describe the life cycle of the barramundi.
10. For how long are female barramundi productive?
11. At what age do barramundi males become females?
12. How can barramundi live in both fresh water and salt water?
13. What term is used for a fish that can:
    a. change sex?
    b. live in both fresh and salt water?
14. What is the growth rate of the barramundi ?
15. At what temperature and salinity do barramundi grow best?
16. What size are barramundi when sent to the grow out ponds? How are they transported?
17. What are the characteristics which make mud crabs so hard to farm?

Exercise 111 Test

Knowledge and understanding



Time 30 minutes

1. Aquaculture is the farming of animals and plants in fresh or salt water by humans. Aquaculture is a most worthwhile enterprise for a number of reasons. Which of the following is NOT a reason:
   a. It provides new products for consumers
   b. It will reduce pressure on wild fisheries
   c. It supplies products other than food. The aquarium fish market is very valuable
   d. It fertilizes the water allowing for an increase in wild species
2. An intensive aquaculture system is where:
   a. There is a large number of animals per unit volume of water
   b. A large water surface area is required
   c. Dams are stocked for recreational fishing
   d. Much of the food required by the cultured animals can be generated by the pond itself
3. Intensive aquaculture systems require many features which are not required by extensive aquaculture systems. Which of the following is NOT a feature of intensive aquaculture?
   a. High labour requirements
   b. High feeding costs
   c. Low pumping costs
   d. Continual monitoring and control of water quality
4. The major reason for the establishment of an aquaculture venture is:
   a. profit
   b. subsistence
   c. research
   d. traditional
5. Fish excrete ammonia through their gills. Ammonia is soluble in water and toxic to fish in high concentration. The build up of ammonia occurs when large numbers of fish are put together in aquaculture ventures. This ammonia problem may be overcome by several methods. Which of the following is NOT a suggested method?
   a. Use of a biological filter
   b. Use of mechanical filtration
   c. Through regular water exchange
   d. Using earthen pond systems
6. The behaviour of aquatic organisms has a significant bearing on their aquaculture potential. Which of the following alternatives is NOT an unfavourable behaviour:
   a. Cannibalism
   b. Aggression
   c. Burrowing
   d. Excessive movement
7. A behavioural problem which makes the cultivation of Western Australian Marron (*Cherax teniumanues*) difficult is:
   a. Migration
   b. Courtship behaviour
   c. Burrowing
   d. Excessive movement
8. The hatcheries of an aquaculture venture:
   a. Are designed so that survival rate between spawning and hatching is greatly improved
   b. Are designed so that young animals are cared for until they are large enough to be introduced into less controlled growout areas
   c. Are used to grow out young
   d. Use culture ponds to provide a concentrated food source
9. The term "brood stock" refers to:
   a. Good quality breeding stock
   b. The fish that are produced in the first breeding season
   c. The fish that have the greatest growth rate
   d. Species from the wild that are large and mature
10. A characteristic of a good brood stock is that they have all but one of the following features. Which of the following characteristics is not desirable?
    a. Good growth rate
    b. Healthy and free of disease
    c. Are able to carry and protect their young
    d. Produce large numbers of viable eggs all year round
11. The Redclaw is proving to be popular with many freshwater farms in Australia because of all except one of the following features. Which feature is NOT a reason?
    a. Grows rapidly over a wide temperature range
    b. Will eat a variety of food
    c. Will tolerate a wide range of salinities
    d. Reaches mature size in three months

Information processing and reasoning

Figure 111.1 is for Questions 12 - 14.

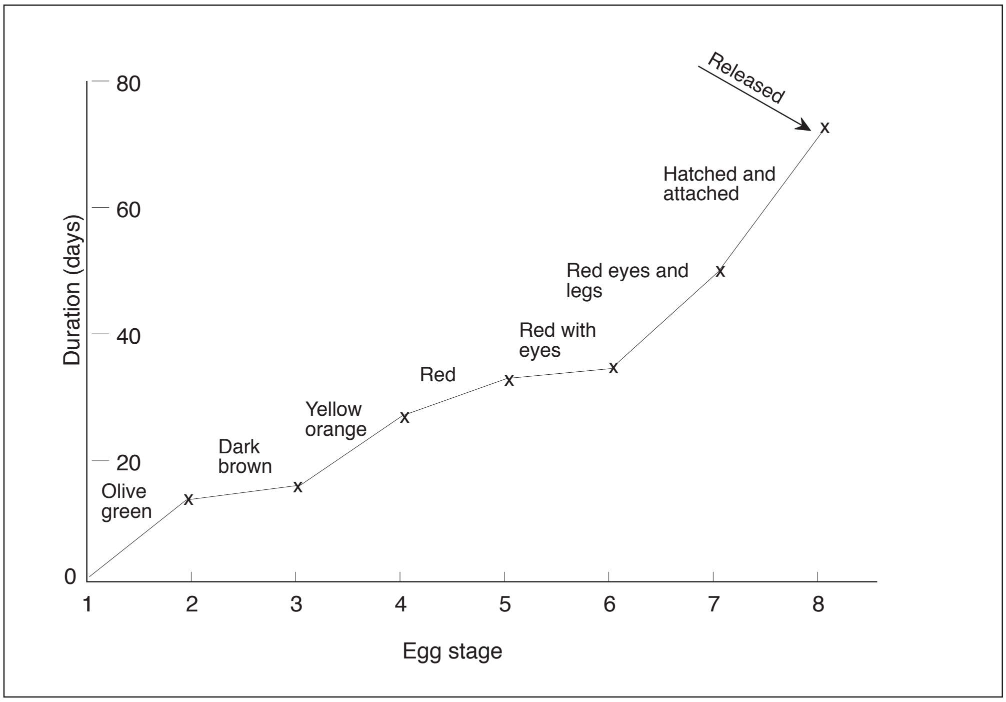


Figure 111. 1 Cumulative stage duration (mean days) of each of 7 stages in the egg development of *Cherax quadricarinatus*, during external incubation (Jones 1989)

12 . The eyes develop after:

a. 15 days

b. 25 days

c. 35 days

d. 45 days

13. The juveniles are released after:

a. 15 days

b. 60 days

c. 70 days

d. 80 days

14. The period of time before the 3rd and 5th egg stage is approximately:

a. 10 days

b. 12 days

c. 16 days

d. 35 days

15. Distilled water will not sustain life. Explain why.

16. During summer, cultured animals are more likely to die due to lack of oxygen. Why?

17. State the stages in a typical aquaculture venture. What are the major features of each?

Use Figure 3 Page 536 of your textbook for questions 18 - 22.

18. Which of these organisms make up most of Australia's aquaculture production?

19. In which industry was the value of hatchery greater than the market? How could these values be explained?

20. a. In which industry is the growth in value most dramatic?

b. By what percentage is this industry growing each year?

c. How might you explain the decrease in value of the edible oyster industry?

21. What industry do you believe has the greatest potential? Explain your reasons.

22. Predict the value of the penaeid prawn industry in 1992. Which factors may make your prediction uncertain?

Answers

1. d	6. d	11. c
2. a	7. a	12. c
3. c	8. a	13. c
4. a	9. a	14. c
5. d	10. c	

SECTION 4
MANAGEMENT AND CONSERVATION

EXERCISE 112
KEY TERMS

QUESTIONS

Obtain a copy of the reference book as shown in Figure 112.1 and write a definition or paragraph that summarises each of the following terms:

1. environmental impact assessment
2. environmental impact statement (study)
3. tourism and ecotourism
4. ecological sustainable development
5. biodiversity

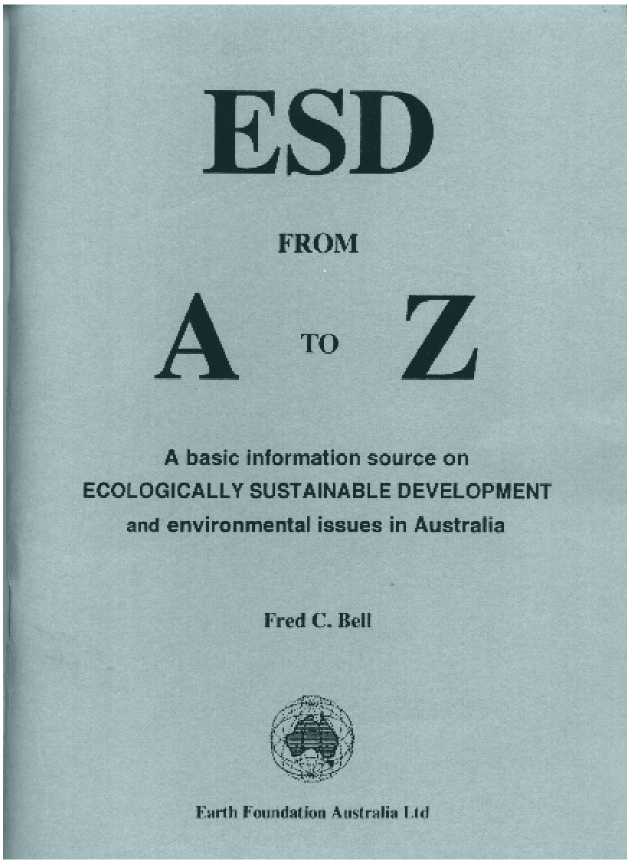


Figure 112.1 Reference book required

MATERIALS REQUIRED (PER GROUP)

Reference book

You will need a copy of the book ESD from A to Z, published by Earth Foundation Australia Ltd.

Available from:

Google Earth Foundation Sydney
or Fax
(02) 9247 7118

Exercise 113 Attitudes and values

Method

1. Arrange for someone to make an overhead transparency of Figure 113.1.
1. Complete the values study exercise in Figure 113.1 by yourself.
2. Now form a group and collate your data in the column to the right.
3. Elect someone to be class recorder and record the group information on the overhead transparency.

Questions

1. Are there any values that over 90% of the class all share?

   If so, write them down.
2. Can you suggest any reasons why the class holds these values so highly?
3. Are there any values that less than 10% of the class hold. If so, which were they?
4. How many values did over half the class hold?
5. Make a summary of the attitude of your class towards the environment.
6. Do you have a personal conservation code? If so, what is it?

Values study		
Place a tick in the space before the sentence if you agree and an X if you don't **Am I a person who...?**	**Group tally**	**Class %**
... expects to slide down bare high dunes		
... expects to catch fish with my grandchildren		
... catches lots of fish and sells some privately		
... couldn't care less how polluted the surf got as long as it was good		
... wants to have access to the beach without being charged a fee		
... collects what I like from the beach and foreshores		
... eats, drinks and is merry and leaves all my litter behind		
... likes skindiving in crystal clear water		
... likes launching my boat from a shoreline littered with broken bottles and cans		
... likes to view the coastline from a lookout		
... takes my dog on the beach		
... walks over rocky pools at low tide		
... likes to visit rocky areas to watch birds nesting		
... can't see what all this fuss is about conserving our seas		
... likes to have safety nets or enclosures at swimming beaches		
... at surf beaches, likes board riders and surfers separated		
... buys and consumes food and drink at the beach		
... likes to get to isolated places easily and cheaply		
... expects the car to be parked close to the beach		
... likes parks and changing sheds close to the beach		
... dislikes greenies forcing their attitudes onto people all the time		
... is appalled by people who are cruel to animals		
... expects to have life-savers guarding the beach		
... wants clean water, clean sand, no litter		
... puts litter in bins provided		
... collects cans and bottles from the beach and takes them to recycling bins		
... enjoys playing tape recorders and radios on the beach		
... likes to tear down trees and light fires on the beach		
... does not want to be surrounded by lots of noisy people		
... is in favour of nude beaches		
... likes fishing in estuaries and bays		

Figure 113.1 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 114 Ecological sustainable development

Questions

Use your copy of ESD A - Z pages 1 – 3 to answer the following questions.

1. Why are timber and water ideal resources to develop? (paragraph 1)
2. What is the difference between ecological and environmental sustainable resource development?

   Why do some people favour the term ecological? (paragraph 2)
3. Who has given support to the idea of ESD and why? (paragraph 3)
4. Modern living has given rise to accelerated resource development. What does this mean and what problems does it cause? Give three examples. (paragraph 4)
5. How does ESD seek to repair the damage caused by development? (paragraph 5)
6. Why do mines have limited economic lives? (paragraph 6/7)
7. Which issues on ESD created much disagreement in the United Nations? (paragraph 8/9)

Examples

Use your copy of ESD A - Z (pages 83 - 94), to write some notes in Figure 114.1 to show how each of the following activities are consistent with the principles of ESD.

1. Fast foods
2. The green olympic village
3. Memtec
4. Cleaning up Australia
5. Local council initiatives
6. Any other local development that you consider to be consistent with Ecological Sustainable initiatives.

Criteria

As a class, draw up a list of criteria you would use to approve an ecological sustainable project based on the information you have gained in this exercise.

Memtec

A green Olympic village

McDonalds

Cleaning up Australia - first Sunday in March

Local council initiatives

Figure 114.1 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 115
Sea rights - three level guide

Questions

Read the next page and then complete the following three level guide. Check Page 42, Figure 19.1 to see how to do a three level reading guide.

For each of the statements write T (true) or F (false) in the space provided.

Level 1 (Literal): Reading for accuracy

Be able to show where these statements appear in the article. Use P for paragraph and L for line.

1. ___ The claim for the Island of Mer arose out of the refusal of Murray Island people in 1982 to accept a lease over the islands from the Queensland Government.
2. ___ The Crown acquired 'radical title' (i.e. ultimate control) to land on colonisation, actual ownership and use rights were removed from Aboriginal people parcel by parcel.
3. ___ Native title to the sea, sea-bed and marine resources has been recognised by courts in England.
4. ___ There is nothing in the Mabo judgement which would seem to preclude the application of native title principles to the sea-bed.
5. ___ In October 1990, the Murray Island Council made claim to Sea Rights.
6. ___ The High Court has now established that the Meriam people of Mer hold a 'native title' to their island under customary law which is recognised under Australian common law.

Level 2 (Interpretive): Drawing conclusions

Be able to show why you arrived at this conclusion with evidence from the article.

1. ___ Sea rights have not yet been settled in court.
2. ___ Many Aboriginal people regard estuaries, bays and waters immediately adjacent to the shore as being part of their land.
3. ___ The limited recognition of Aboriginal interests in the sea provided by sea closures under Northern Territory legislation has been shown to be inadequate in achieving harmonious management of the Top End coastal waters.
4. ___ It now seems unlikely that a 2 km buffer zone alone would have fully protected the legitimate interests of Aboriginal people.
5. ___ Another term used in dealing with sea rights is customary marine tenure (CMT). What do you think this means?
6. ___ Native title only applies to Australian indigenous people.

Level 3 (Applied): Defending your opinion

Be able to give reasons (argue) why your answer is correct. You may draw on information from other sources to justify your answer.

1. ___ Why does a proposed buffer zone fail to recognise the coastal sea as an integral, inseparable part of Aboriginal Country?
2. ___ The purpose of the Racial Discrimination Act of 1975 was to protect the rights of Aboriginal people. How did the then Queensland Government contravene it?
3. ___ Why should Aboriginal and Torres Strait Islander people have a right to hunt by traditional methods?

The High Court Decision

By a 6-1 majority the High Court made a judgement in favour of Mr. Eddie Koiki Mabo and others in their claim against the Queensland Government for recognition of their native title to Mer – one of three islands of the Murray group in eastern Torres Strait. The finding effectively overturned the long held legal doctrine of *terra nullius,* which had maintained that Australia was unoccupied territory prior to 1788.

The claim arose out of the refusal of Murray Island people in 1982 to accept a lease over the islands from the Queensland Government. The Murray Islanders maintained that the Queensland Government was not in a position to grant a lease over the islands since the Murray Islanders themselves were already the owners under customary law. During the ten years of legal proceedings that ensued, the Queensland Government passed new legislation, the *Queensland Coastal Islands Declaratory Act 1985,* which purported to extinguish any native title to the Torres Strait Islands should such a title continue to exist. In a separate High Court action in 1988 the Murray Islanders established that this legislation contravened provisions of the Racial Discrimination Act 1975. The *Queensland Coastal Islands Declaratory Act* was therefore declared invalid and the original claim for recognition of traditional ownership of the Murray Islands proceeded to the High Court.

The High Court has now established that the Meriam people of Mer hold a 'native title' to their island under customary law which is recognised under Australian common law. The court also found that native title could be extinguished by explicit legislative acts, or by removing customary owners from their land, or by otherwise destroying the customary law under which such native title is held. However, as happened in the Murray Island case, attempts to extinguish native title by administrative or legislative means may contravene provisions of the *Racial Discrimination Act 1975*.

The immediate impact of the decision applies only to the land of the island of Mer in the Murray group. The importance of the case nationally rests with the extent to which it may have firstly set a legal precedent, and secondly altered the way in which Aboriginal and Torres Strait Islander people may hitherto expect to interact with governments on land, sea and resource management matters.

The original claim by Mabo and others included a large area of sea territory surrounding the Murray Island group, including both Commonwealth and Queensland waters and sea-bed. Claims for Commonwealth and Queensland waters were withdrawn as the case proceeded, in part because a Queensland Supreme Court judge determined the customary practices in relation to the ownership and use of fringing reefs were no longer in operation, so that the High Court was only called upon to bring down a decision in respect of the land of the Island of Mer.

As it was made clear during consultations with Meriam people during the inquiry, there was still a determination to proceed with claims on the other two islands and surrounding waters. In October 1993 the Murray Island Council announced its intention to control commercial fishing in waters surrounding the island and indicated that a formal native title sea rights claim would be lodged with the Commonwealth Government in the near future. (See "Sea rights ban hits trawlers," *Courier Mail* 28 October 1993.)

Dimensions of the Mabo Judgement

As has been noted by several legal commentators (e.g. Brennan 1992, Nettheim 1992 and Bartlett 1993) the fundamental implication of the High Court judgement is that British acquisition of sovereignty over Australia and its islands did not in itself bring about a transfer of ownership of the land from the indigenous people to the Crown. Although the Crown acquired 'radical title' (i.e. ultimate control) to land on colonisation, actual ownership and use rights were removed from Aboriginal people parcel by parcel over time as European settlement advanced, as land grants were made and as Aboriginal people were killed, displaced or removed from their traditional estates. Where such events have not happened, and where Aboriginal and Torres Strait Islander people continue to have a relationship to their country based on customary law, then native title may continue to exist and if so is recognised under Australian common law.

Although the Mabo judgement referred only to land, coastal Aboriginal people, as well as the Meriam people and other Torres Strait Islanders who participated in the consultation process, have expressed optimism that their claims to ownership of customary marine estates may also be recognised. This possibility is under active consideration by legal advisers to Aboriginal organisations around the country and was raised during meetings with Commissioners at Broome, Cape Leveque, Maningrida, Cairns, Yarrabah, Gordonvale and Palm Island as well as at formal hearings in Darwin (Transcript, p. 997). Several native title claims which include extensive areas of sea country have already been lodged in courts in Western Australia and Queensland. (The Utemorrah claim in the King Sound area Western Australia and the Fraser Islander claim in Queensland).

The issue of native title over marine estates following the Mabo decision was the subject of a submission to the Inquiry which concludes that:

'Common law recognition of customary marine tenure is highly likely following the Mabo decision . . . there is nothing in the judgement which would seem to preclude the application of native title principles to the sea-bed. (Ms. Joanna Sutherland 351, p 2)'

The likelihood that native title can exist and has persisted in marine environments is supported by many legal commentators, including the Office of General Counsel of the Commonwealth Attorney General's Department. That office has advised the Great Barrier Reef Marine Park Authority that although native title is unlikely to the ownership of the sea, sea-bed or natural resources, claims for native title use rights 'have a good prospect of success.' (Mabo: Implications for The Great Barrier Reef Marine Park . . Advice from Office of General Counsel the Great Barrier Reef Marine Park Authority, p 13, 20 May 1993)

Professor Richard Bartlett, an expert on native title law in the United States and Canada, has pointed out (Bartlett 1993) that native title to the sea, sea-bed and marine resources has been recognised by courts in Canada, United States and New Zealand. He concludes:

'*Mabo* extends to the sea. There may be problems of proof, but they will be no more onerous than on land. Indeed the difficulties of establishing native title in the off-shore may be less than on land because of the lesser extent of inconsistent grants . . .

Native title at common law protects the traditional relationship of Aboriginal people to their environment. To the extent that the environment includes the sea, it is included within the compass of native title. Australia's arrangements to accommodate the rights of non-Aboriginal and Aboriginal people must recognise native title rights to the sea. (Bartlett 1993, p 17)'

The implications of the judgement for particular areas of Australia, and the current status of native title over particular parcels of land or water, are not matters for consideration here. It is essential, however, that any recommendations for improved coastal zone management should take note of the probability that some coastal and marine environments and resources are subjected to native title in common law.'

Figure 115.1 From an article called, “A voice in all places Aboriginal and Torres Strait Islander Interests in Australia's Coastal Zone”, by Dr Dermot Smyth which was prepared for the Coastal Zone Inquiry, Resource Assessment Commission, reproduced with permission, copyright Commonwealth of Australia 1993.

EXERCISE 116 TERRITORIAL WATERS AND AFZ

Note: AFZ = Australian Fishing Zone

QUESTIONS

1. Mark in Figure 1.1 opposite, the following places.

   Sumatra, Java, Timor, Kalamantan, West Irian, Papua New Guinea, Cocos Is, Christmas Is, Australia, New Zealand, Antarctica, Lord Howe Is, Norfolk Is, Kermadec Is, Chatham Is, Macquarie Is.

2. Use coloured pencils to distinguish between the AFZ of Australia and New Zealand.

3. Draw lines in coloured ink to show the territorial waters of Australia and New Zealand.

4. By counting in squares, calculate the percentage of land and sea for Australia and New Zealand and record your data in Figure 1.1 Which has the greatest AFZ and territorial water?

5. Use your book, ESD A to Z, (Page 32), to answer the following questions.

   a. Why should fish stocks be managed in an AFZ? (paragraph 1)

   b. Which fisheries of the Australian AFZ are over-exploited? (paragraph 2)

   c. How will aquaculture sustain our fisheries? (paragraph 2)

   d. Give three examples of difficulties encountered in preventing fish stocks in the AFZ from being over exploited. (paragraph 3)

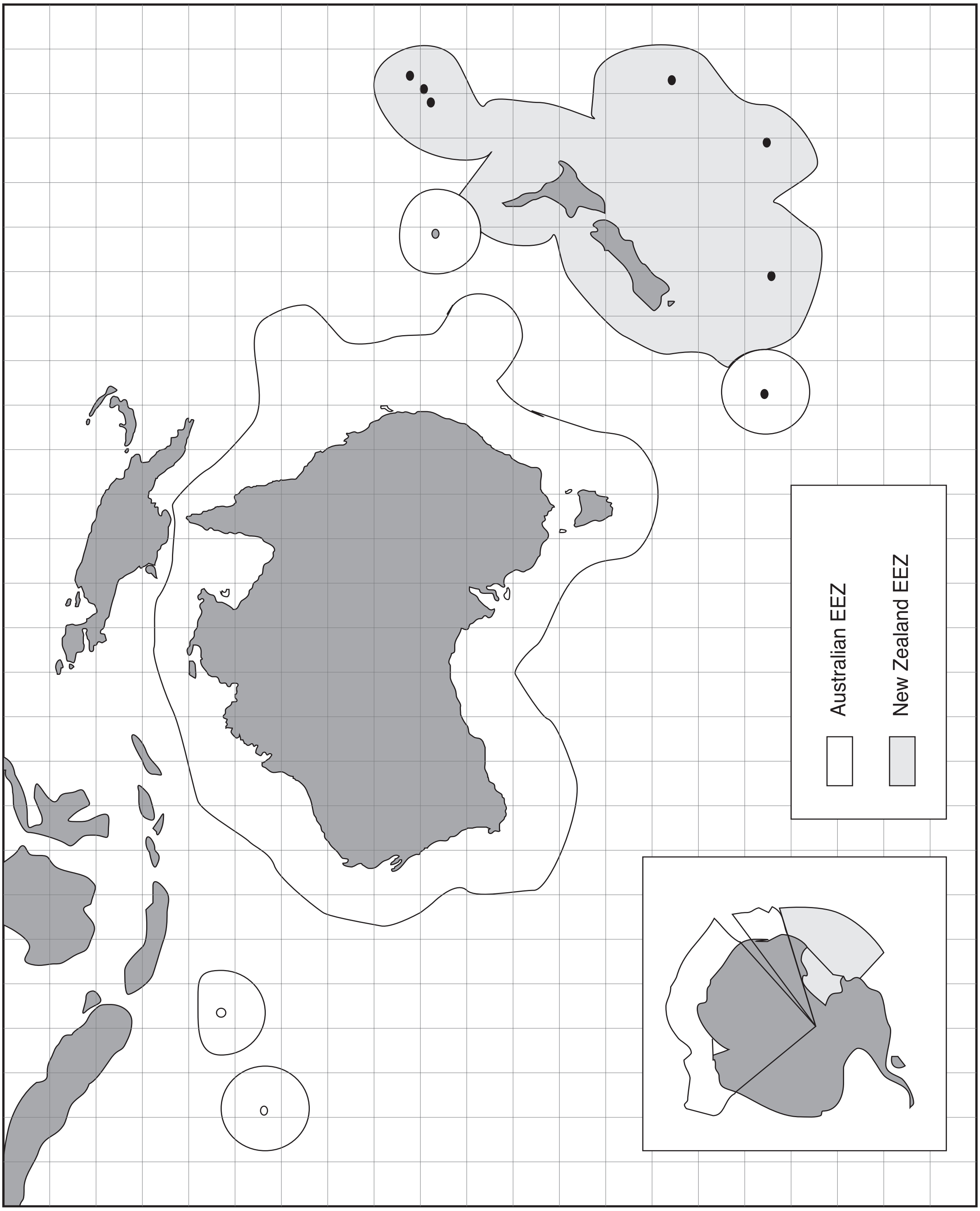
   e. What is the tragedy of the commons and how can it apply to the AFZ? (paragraph 4)

   f. Explain how water pollution, coastal development and poor catchment practices make it difficult to maintain biodiversity in the AFZ. (paragraph 5)

MATERIALS REQUIRED

- colouring pencils
- reference book — ESD from A to Z. Published by Earth Foundation Australia Ltd.

  Available from:
  Total Environmental Centre Bookshop
  1/88 Cumberland St. Sydney 2000
  Tel. (02) 241 2523 Fax (02) 247 7118



Australia		New Zealand	
Number of squares occupied by land	=	Number of squares occupied by land	=
Number of squares occupied by sea	=	Number of squares occupied by sea	=
Total number of squares	=	Total number of squares	=
Percentage of land	=	Percentage of land	=
Percentage of sea	=	Percentage of sea	=

Figure 116.1 Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 117
Multiple use

Questions

Turn to your textbook (Page 65) and locate the colour map of the Great Barrier Reef Marine Park in Figure 5 and complete the activity in Figure 117.1.

1. Make a list of activities that are permitted in this section of marine park.
2. Why is oil drilling and mining not allowed?
3. Why are colours used to indicate multiple use?
4. What activities are prohibited in green zones?
5. Locate Man and Wife Rocks. Can you trawl for scallops there?
6. Can you camp on North Keppel Island? If so, is a permit required?'
7. A school excursion is planned to North Keppel and members of the party wish to fish. Can they and what limits are there?
8. Why have multiple use zoning?
9. Should these zones be in place for all time and if not, how many years should elapse before they are reviewed?
10. Use colouring pencils to shade the zones using the colouring scheme in your textbook Page 65.
11. What is the purpose of the pink and orange zones

Extension questions

1. Write to the Great Barrier Reef Marine Park Authority for up to date zoning maps of this area. Have the zones changed in Figure 117.2 since 1991?
2. Is there a preservation zone? Explain your answer.
3. Are there any pink and orange zones in the Marine Park? If so, where and what proportion of total park are they?
4. Do you think this is enough? Give two reasons.

Materials and equipment (per group)

- Dark blue, light blue, green, yellow, orange and pink colouring pencils
- Copies of this map are available from:
  Great Barrier Reef Marine Park Authority
  PO Box 1379 Townsville 4680

Learn the zones

1. Make a copy of Figure 117.2
2. Use the colours and map in your textbook (Page 65) to make a colour map of the Keppel Island Group.
3. Make sure you colour accurately the following zones:
   - General use A
   - General use B
   - Marine Park A
   - Marine Park B
   - Scientific research zone
   - Preservation zone
   - Seasonal closure areas

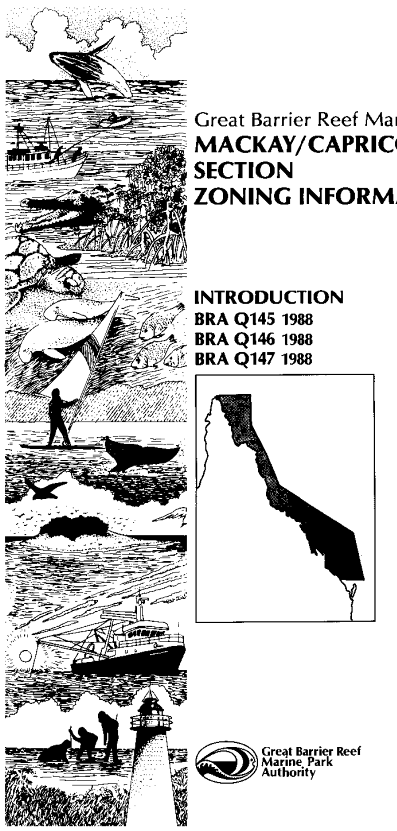


Figure 117.1 Learn the zones activity

Permitted activities guide

	Bait netting and gathering	Camping	Collecting (recreational not coral)	Collecting (commercial)	Commercial netting (see also bait netting)	Crabbing and oyster gathering	Diving, boating and photography	Line fishing (bottom fishing, trolling etc)	Research (non-manipulkative)	Research (manipulative)	Spearfishing	Tourism and education (facilities and programs)	Traditional hunting (fishing and gathering)	Trawling
General Use A Zone	Yes	Permit	Limited	Permit	Yes	Yes	Yes	Yes	Yes	Permit	Yes	Permit	Permit	Yes
General Use B Zone	Yes	Permit	Yes	Permit	Yes	Yes	Yes	Yes	Yes	Permit	Yes	Permit	Permit	No
Marine Park A Zone	Yes	Permit	No	No	No	Limited	Yes	Limited	Yes	Permit	No	Permit	Permit	No
Marine Park B Zone	No	Permit	No	No	No	No	Yes	No	Yes	Permit	No	Permit	No	No
Scientific Zone	No	No	No	No	No	No	No	No	Permit	Permit	No	No	No	No
Preservation Zone	No	No	No	No	No	No	No	No	Permit	Permit	No	No	No	No
Replenishment Zone	No	No	No	No	No	No	No	No	Permit	Permit	No	No	No	No

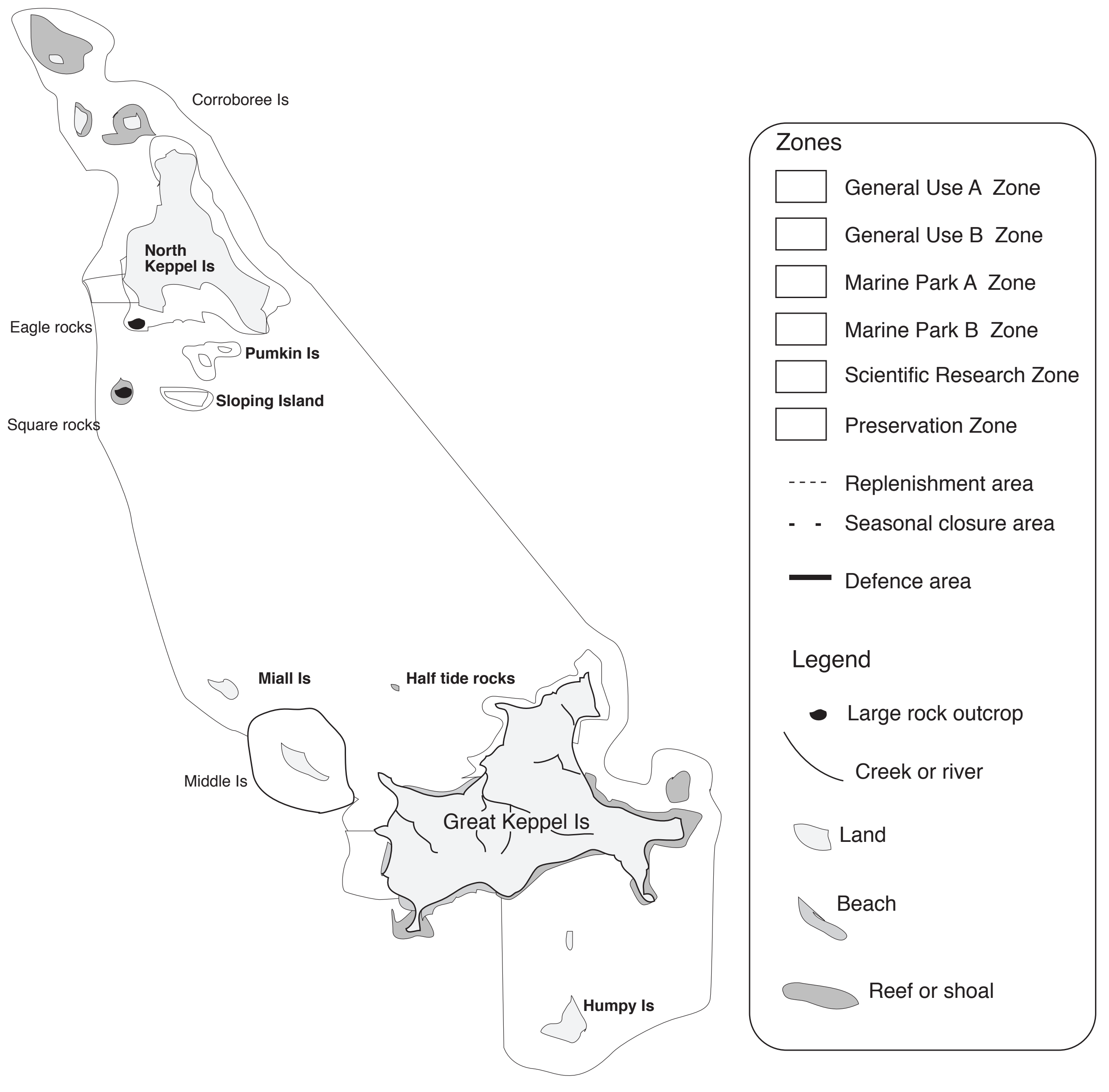


Figure 117.2 Students may make one copy of this page so that they can attach their answers before handing in for marking.

EXERCISE 118 MANAGEMENT STRATEGIES

RESEARCH PROJECTS

Read the following projects and select one to do as a term report.

1. Prepare 10 questions you might ask the Minister for the Environment about a local or important issue in a television interview. Read the boxed section in Figure 118.1 for some ideas.

2. Prepare 10 questions on strategies applied by various government authorities to manage the local environment and conserve marine resources.

   To whom might you direct these questions.

3. Figure 118.2 shows a community based coastcare program. Locate one in your area and find out what strategies people are using to manage the coastline. Many dunecare groups involve many community members. Find out what they are doing and how they are achieving their targets. Also make a list of frustrations they have encountered in attaining their goals.

4. Figure 118.3 shows a government report into proposed management strategies which gives a very detailed discussion on coastal management issues. Ask your teacher/librarian to obtain a copy and write a report on it detailing what was covered and outline some of the key strategies proposed. Don't be overawed by the size of reports as most give executive summaries.

4. You are to develop a management plan.

   Find a local case study and document what, why, how, when and where management occurred.

   You might like to consider if the following were completed:

   a. Were public meetings held to develop a shared vision for the area? Where were they held and how effective were they?

   b. Were objectives set and strategies put in place? If so, by whom and when did these occur?

   c. Was information gathered regarding the projected usage of the area? Did the strategies take into consideration population growth, increased farming or tourist facilities?

   d. Was speculation made about the effects of change, both good and bad?

   e. Was a draft plan produced and available for public comment?

   f. Is there a review process and what strategies were used to publicise the plan?

Structure of an interview

This section focuses on strategies applied by various government authorities to manage the local environment and conserve marine resources.

The purpose of an interview is to exchange information or opinions between people. It can be entertaining but most new interviews are completed to gain a better understanding of the subject.

The structure could go like this:

a. Introduction
   - Background information on participants
   - Purpose of interview

b. Questions and answers
   - Can be opened or closed questions
   - Can be prepared or unprepared questions
   - Keep purpose in mind

c. Closure
   - Thanks
   - Contain a summary

Figure 118.1 Ideas on the structure of an interview

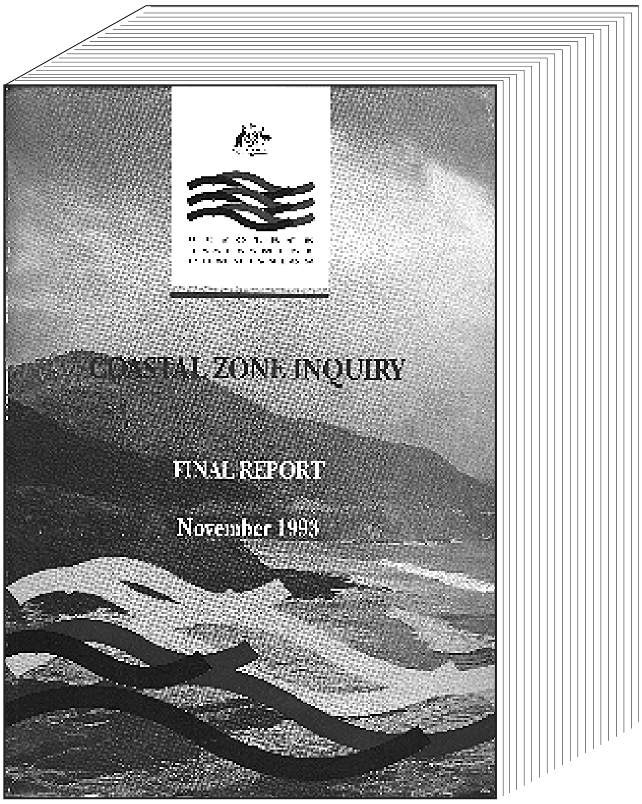


Figure 118.2 A government report

Addresses for government reports

Be aware that as Governments change so does the structure of their departments. What one year is the Department for the Environment could be Department for Oceans and Coasts under a new government.

The following department was current at time of publication (June 1995).

Department of Environment Sport and Territories, Parliament House, Canberra.

Exercise 119
Why are MEPAs necessary?

Questions

Read the information in Figures 119.2 and 119.3 and answer the questions below.

1. What do the letters IUCN stand for?
2. What do the letters MEPA stand for and why are they important?
3. In the cases of Green Island and Port Noarlunga, MEPAS are threatened. Management plans may be in place, and strict regulations operating, but the environment is still suffering.

   Both need longterm solutions —□what would you suggest?
3. What are some of the strategies applied by local government authorities to manage the local environment and conserve marine resources? Use the following list to generate ideas:
   - disposal of waste into the sewage system
   - multi-use zones
   - restrictions on sand mining

Extension activities

Contact your local Greenpeace office (Use the phone book) and find out if the 'Adopt a Beach' Campaign operates in your area. Alternatively contact the national office of the Surfrider Foundation on (07) 55 350999 to find out who your local beach representative is.

A local co-ordinator will provide kits for recording rubbish, and suggest how to dispose of the rubbish safely. Then do a clean up! If you have no local group, perhaps your school can start one, using parents to help with moving the rubbish to the tip or recycling objects like bottles and cans.

1. Why should community groups be involved in campaigns such as this?
2. Do you know of any other local campaign?
3. How can individual actions be incorporated into Coastal Management and Conservation Plans?

Wet Paper

Figure 119.1 A coastcare program

Read this

In response to demands from the Australian Committee of the International Union for the Conservation of Nature (IUCN), Marine Protected Areas have been established in all states, territories and some off-shore territories. By September 1991, Australia had 173 Marine Protected Areas (**MEPAS**) covering over 39 million hectares, including aquatic reserves, fish habitat reserves, fish sanctuaries, wetland reserves, marine parks and marine reserves. However, if the Great Barrier Reef Marine Park is excluded, only 0.57% of the whole coastal zone is included in a MEPA, so there is still a lot of protection to be done. MEPAS mean that regulations controlling what happens in the area are set down by law. Policing these laws is usually the responsibility of either State Rangers or Conservation Officers, Fisheries Officers, or in some cases, local authority rangers.

A conference of various interested bodies in Canberra late in 1991 agreed that a Coastal Management Strategy should be developed for all Australian waters and coasts.

Greenpeace, the international conservation campaign body, launched an Australian 'Adopt a Beach' campaign in 1990, in an effort to get local residents to take responsibility for cleaning up their own beaches, and to collect, sort and record the types and amounts of rubbish picked up. This data would then be added to the world wide data bank, and appropriate measures taken to eliminate or reduce the dominant types of rubbish. Groups have been set up all around Australia many working with local councils. Everyday, a bunch of locals, school children, pensioners or visitors can be found somewhere, picking up plastic, straws, containers, fishing lines, bottles, cans and tyres.

Figure 119.2 Marine and protected areas

Port Noarlunga

Port Noarlunga in South Australia is an Aquatic Reserve, where it is forbidden to remove shell, rock, coral, sponge and plant material from the water or foreshore. No fishing is permitted within 25 m. of the reef, which has interesting rock formations, soft corals and numerous other marine life. Fishing with a rod is permitted in other parts of the reserve. Close by, major pipelines discharge stormwater from nearby small townships. Most of the houses are not connected to the sewer, so effluent from septic tanks often trickles into the gutters and local drains. When it rains, this effluent is washed into the sea through the stormwater drains. Local divers and tourists are reporting that the marine life around the reef in the Reserve is changing, with far more sea grass and algae growth. This is possibly due to the increased supplies of phosphorus and other nutrients just as at Green Island. The local Shire council knows what is happening, but feels it can do little as the existing sewerage plant, operated by the Council, could not handle any more sewage.

Green Island

Green Island off Cairns in North Queensland was the first Marine Protected Area. In the 1940s, its reef and cay were in excellent condition, and a small resort catered for the overnight visitors who boated out from Cairns. However, as demand from tourists increased, sewage from the island was discharged over the reef flat. The increase in nutrients provided by the sewage encouraged the growth of seagrasses and algae around the island. The natural flow of water and sand around the island also moved sand and coral rubble, and gradually the living reef around the island has disappeared. Vast areas of algae now cover the old coral, and the whole reef ecosystem has changed. Only in the past ten years has the sewage outflow been controlled, but as yet, the coral has been slow to recover. A Management Plan to control extensions to the resort, upgrading of the jetty and the rebuilding of an underwater aquarium is now operating, but some scientists in the Great Barrier Reef Marine Authority consider the island may never regain its former coral environment.

Figure 119.3 Strategies applied by various government authorities to manage the local environment and conserve marine resources

Exercise 120
Trade waste

In many Australian States proposed or existing legislation prohibits the discharge of any chemical into the marine environment. This means the only place chemicals can be discharged is into the sewage system.

This exercise involves analysing local trade waste by laws and how they affect the marine environment.

Class talk

Invite a trade waste inspector from your local authority to visit your class to discuss rules and regulations that pertain to the disposal of chemicals .

- Prior to the talk, write a letter sending a copy of this exercise and the table opposite.
- Indicate that names of companies are not required, but the class would like some general information about the types of business or industry that discharge into the sewer and some of the chemicals that are discharged.
- Complete Figure 120.1 (Table 1) during the talk and then arrange for a visit to the sewage or waste water plant to see how this waste is treated.

Excursion

Arrange an excursion to the local wastewater treatment plant, complete the table in Figure 120.1 (Table 2) and research the following questions.

1. How many mega litres does the plant treat each day.
2. How far from a marine protected area or conservation area of significance does the plant discharge its waste water?
3. Is the plant primary, secondary or tertiary in its treatment of sewage?
4. Does the plant remove heavy metals and if so how?
5. What are the licence requirements of the plant and are these licence requirements met?
6. Is the waste water recycled on land and if so how?

Additional references

Both are available from Wet Paper Publications.

- WaterWise - Resource management and conservation.
- Pollution - issues in marine conservation, Tim Ryan.

Table 1

Type of industry/school or domestic property	Some of the chemicals it discharges

General comments on potential harm to marine resources if waste discharged directly into creeks and rivers

Stage of treatment	Type of chemical removal

General comments on the effectiveness of the sewage plant in conserving biodiversity of marine life

Figure 120.1 Disposal of chemicals in your area. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 121
Local management issues

Questions

It has long been recognised that community groups can make a difference by thinking and acting globally. Watch the video, Green Bells, produced by a local group of surfers and answer the following questions.

1. Where is Bells Beach located and what is it famous for?
2. What were the local management issues described in the video?
3. What involvement did the local community undertake as a management practice?
4. Name some simple conservation steps that you can do if you go to the beach.
5. Professional surfer Shane Powell made a statement that Australian beaches were amongst the cleanest in the world and that each year, beaches he surfed at overseas were becoming more polluted.

   What is the value of a clean beach to the Australian economy? What is the link between our economic growth and litter free and well managed beaches?

Research project

In some Australian States it is illegal to discharge any chemical into the marine environment. The responsibility for implementing this law lies with local government.

Conduct a local authority conservation audit to find out what your local council is doing to protect local beaches by using the checklist in Figure 121.2.

Material required

- a copy of the video, Green Bells available from:

  Golden Seahorse
  Productions
  c/- Surfrider Foundation
  PO Box 444 Mermaid
  Beach Qld 4218
- video player and monitor

Surfrider Foundation
Conservation Activism
Research Education

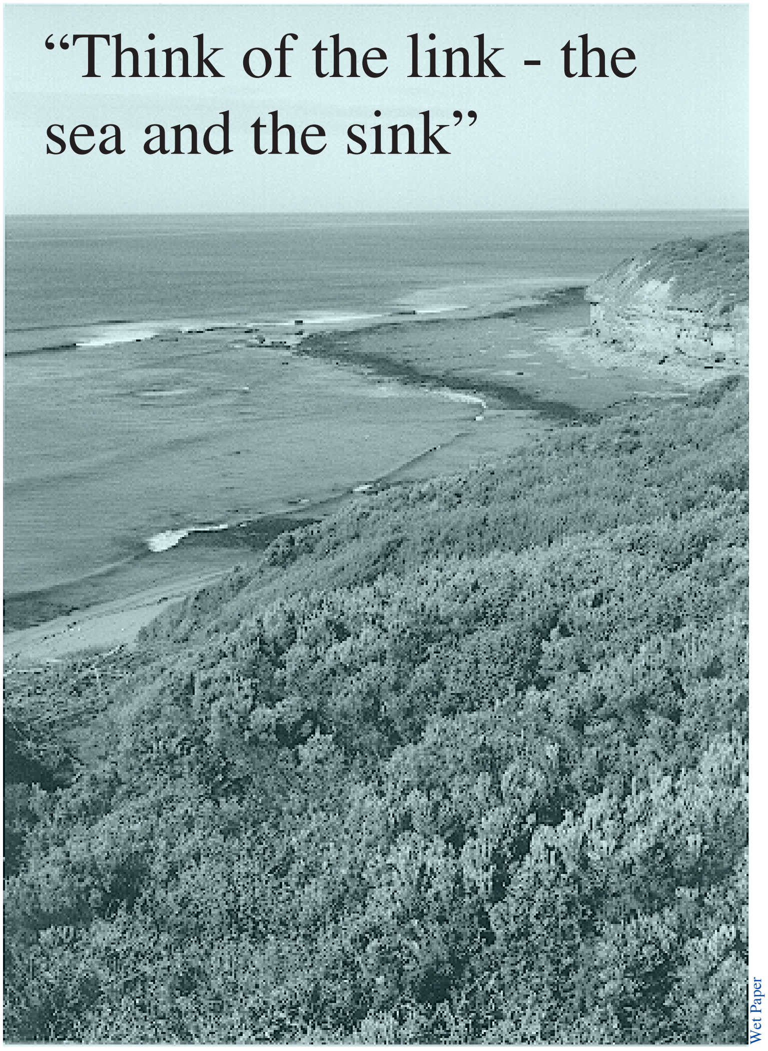


Figure 121.1 Bells Beach, Victoria

Local authority conservation survey

1. Is there a catchment management committee in council?
2. Does the council provide places for residents to recycle cans, bottles, glass?
3. Is there a recycling program in your school?
4. Are compost bins in homes part of council's agenda?
5. Is there a compost bin system in your school?
6. Does your council have a water conservation policy and education program to reduce the amount of water that flows to the sewage plant?
7. Do local schools and community groups have a Waterwatch group? If so how effective is it and does local council support it?
8. Is there an oil spill team trained in your council? If so, what equipment do they have and what measures are in place to combat oil pollution?
9. Is rubbish collected from the streets by council workers or community groups?
10. Are beaches regularly cleaned?
11. Are there walkways provided at your local beach to protect sensitive dune areas?
12. Is rubbish cleaned from car parks at the beach or local ramp?
13. Does the council encourage people to take their rubbish home?
14. Does your local council have an education program for solid waste minimisation?
15. Identify six practices in which your school/council is able to reduce, reuse or recycle the waste it is generating.

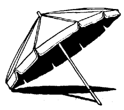


Figure 121.2 Conservation survey ideas

EXERCISE 122
ADOPT AN NGO

Note: This exercise needs to be started at the beginning of the year.

Non government organisations (NGO's) play a vital role in bringing attention to marine conservation issues.

Some of these organisations include:

- The Australian Marine Conservation Society (formally ALS)
- Marine Educators Association of Australasia
- Surfrider Foundation
- Australian Conservation Foundation
- Nature Conservation Agency
- Greenpeace
- Australian Surf Life-saving Association

All rely on donations and membership fees to continue their work and volunteers who give their time to help protect our seas.

CLASS ASSIGNMENT

Use the telephone book or other resources you can think of, to find out the name of a non government organisation that supports the conservation of the sea.

Find out how much it costs to join each association and when you have tallied up all the costs, organise a fund-raiser to raise sufficient cash to join each for one year.

You could form groups and adopt an NGO.

Once you have joined, read through their literature to see how they go about protecting the marine environment.

You could consider the following as a checklist.

- Does the group organise protest rallies?
- Is a newsletter produced?
- Does the group respond to calls for public submissions to management proposals?
- What issues does the group take a firm stand on?
- How much media coverage does the group generate if it feels that this is an avenue to achieve its aims?
- Does the group prepare reports, conduct field days, organise events such as Seaweek, Ocean Care Day?
- If these events are conducted, how can people become involved?

An example of an NGO is Surfrider Foundation

This association has the following principles.

1. The Surfrider Foundation has adopted the following principles to guide and govern the activities of the organisation.
2. Surfrider recognises the biodiversity and ecological integrity of Australia's coast are necessary and irreplaceable. Surfrider is committed to preserving natural living and non-living diversity and ecological integrity of the coastal environment.
3. Surfrider promotes the right of low-impact, free and open access to Australia's oceans, waves and beaches for all people. Surfrider acts to preserve this right of access.
4. Surfrider is dedicated to enhancing coastal recreational opportunities in ways which will not adversely impact near-shore ecosystems.
5. Surfrider believes environmental education is essential to the future health and well-being of the planet. Surfrider seeks to develop and utilise educational materials that are informative, factual, proactive, synergistic and fun.
6. Surfrider strives to be accurate and nonpartisan in its communications with its members and the general public.
7. Surfrider is a grassroots organisation effective through the participation of its members. Surfrider activities emphasise the value of involved membership.
8. Surfrider encourages all commercial enterprises to adopt the Valdez Principles. Their determination to do so will favourably influence Surfrider's willingness to provide support. Surfrider will not permit sponsors to divert Surfrider from its mission or projects undertaken.
9. Surfrider does not discriminate on the basis of sex, religion, race or national origin for any reason. Surfrider promotes the healthy enjoyment of the coastal environment for all people.
10. Surfrider and its representatives, affiliations and branches agree to abide by these principles and rules governing non-profit organisations.

Figure 122.1 The Surfrider Foundation is dedicated to the conservation, management and education of the sea by activism, education, conservation

Exercise 123 MESA Seaweek and Ocean Care Day

Seaweek is organised each year by the Marine Education Association of Australasia or MESA. Ocean Care Day is organised by Surfrider Foundation, Ocean Rescue 2000 and the Australian Conservation foundation.

Here are some themes and activities that have worked in the past and which your class could do to draw attention to the need to create awareness of the marine environment.

Themes

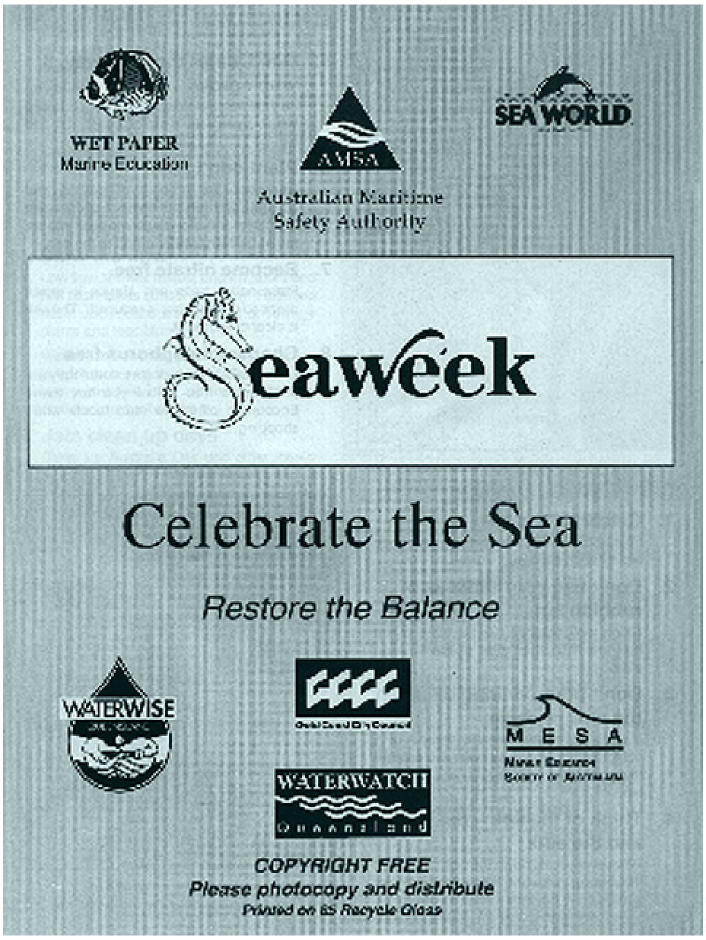
- Caring for our Coast, Celebrate the Sea, Fish for the Future, Respect the Beach
- Why not come up with your own theme?

Activities

- Discovery tour to local island
- Face painting, reef mural, static displays
- Marine Olympic competition
- Water testing for pollution
- Beach clean-ups
- Public seminars
- Poster competitions in schools
- School video competition
- Production of 30 second TV commercial
- Beach concert
- Diving workshops
- Surfing competitions
- Planting trees
- Sand sculpturing competitions
- Aqua shell orchestral concerts
- Coastal walk-a-thon
- Adopt a beach activities
- Aboriginal dreamtime stories
- Writing articles for local newspapers
- Displays in libraries and shopping centres
- Environmental plays
- TV environmental segments

Wet Paper

Figure 123.1 MESA is the group who organise Seaweek each year about Easter time. Why not make a banner like this one? (The author grateful acknowledges Jan Thornton from MESA for providing the opportunity to take this photograph)



Wet Paper

Figure 123.2 Why not design a brochure for Ocean Care Day or Seaweek?

Wet Paper

Figure 123.3 Why not organise a beach clean up and group surf for a Sunday in Seaweek?

EXERCISE 124
LIVE FISH EXPORTS

Based on an original exercise by Tim Ryan, Maryborough State High School

RESEARCH REPORT

1. What is the difference between renewable and non – renewable resources? Watch the video on the Port Lincoln fishing industry.
2. The 1990´s have seen an increase in live fish exports. What countries are buying our live fish?

   Why do you believe the people in these countries are paying more money for live fish?
3. Fishers are seeing the increased returns and are being attracted to this money. What extra costs might be involved in gaining access to this market?
4. Stressed fish are less likely to survive transport and more likely to contract disease. How could this problem be overcome?
5. Most fish have to be sent in live tanks. The understanding is that the biology of the fish is important for the survival of the fish in the tanks.

   Some problems that need to be investigated are:

   - fish densities
   - disease

   How will these factors affect fish survival?
6. What physical conditioning in the tanks might need to be researched?
7. Disease in an inevitable consequence of placing well fish into tanks with high fish densities. How could this problem be overcome?
8. Evaluate the type of seafood that would have the best potential for live export. Would mudcrabs have a greater potential than barramundi? Explain the reasons for your choice. List some species that would have limited potential for live export and outline the reasons for your answers.
9. Research the topic, 'Live Fish Exports' and list:

   a. species now being exported

   b. cost of the product at the market

   c. problem encountered

MATERIALS REQUIRED

- video player and monitor
- copy of the video:

  Port Lincoln Fishing Industry
  available from:
  Port Lincoln Apex Club
  PO Box 626 Port Lincoln SA 5606

QUESTIONS ON THE VIDEO

As an introduction to this research report, watch the video produced by the Port Lincoln Apex Club and answer the following questions.

1. Find a map of Australia and make a mud map of the Port Lincoln area.
2. How are tuna caught?
3. What controls have been put in place to protect the renewable resource?
4. What is the method used to develop the live fish export market?
5. How many hours elapse between when the tuna is caught and when it arrives on the Japanese restaurant table?
6. What other fish are caught in the Port Lincoln area and how are these marketed?
7. What management processes are in place to protect these species?
8. Did you enjoy this video? If so, write a letter to the Apex club encouraging their efforts to support a local industry.

   See if you can arrange a student exchange program from one marine class to another via the Apex club in your area.

Figure 124.1 Questions on the video

Figure 124.2 Tuna is a renewable industry (The assistance of Geoff Bailey, SA MESA, is gratefully acknowledged in providing the opportunity to take this photograph)

Exercise 125
Oil and gas

Research report

Write for the brochures and materials listed below and answer the following questions.

1. Is petroleum a renewable or non-renewable resource?
2. Look at the photo on Page 3 of the book shown in Figure 125.1. How many products are the boys wearing that are made from petroleum products? Compare these with what you are wearing today. How many renewable and non-renewable resources are you wearing?
3. Read pages 6 and 7 of the book and draw a diagram to show how oil and gas have become trapped under the sea. Check also the Figure on Page 11.
4. Write a summary paragraph on the offshore production of petroleum from Pages 15-16.
5. Locate the picture you see in Figure 125.2 in the book and describe the role of the oil spill centre in Geelong. Describe how it responds to an oil spill.
6. Obtain the supplementary map supplied with the book and locate your nearest oil field to work out how far oil and gas comes from.
7. Why is there no offshore oil drilling off Townsville?

Materials required (per group)

- copy of the Australian Petroleum Resource Book available from:
  The Education Advisory Section
  Australian Institute of Petroleum
  Google their new address
- AMOSC brochures on oil spills available from:
  The Australian Marine Oil Spill Centre
  Google their new address or try AMSA

  www.amsa.gov.au
- Our World Project Materials available from:
  Our World Project
  Google their new address

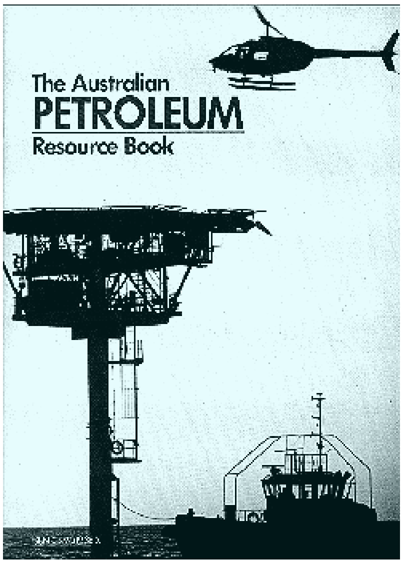


Figure 125.1 Write for this book from the Australian Institute of Petroleum

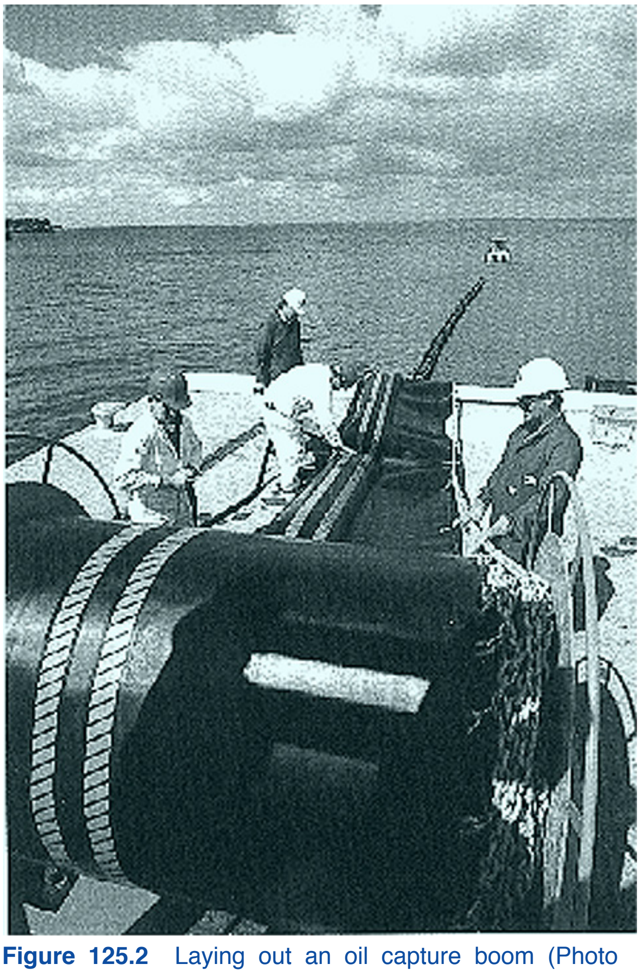


Figure 125.2 Laying out an oil capture boom (Photo courtesy Australian Institute of Petroleum)

Exercise 126 Locations of Australian fisheries

Research project

1. Select one invertebrate and one vertebrate species from the book shown in Figure 126.1 and outline its distribution in the map from Figure 126.2.
2. Outline the extent of the fishery for each in the space provided.

Extension

On a separate sheet make a description of each of the following:

a. Life history
b. Catch numbers over the past three seasons
c. Recreational fishery (if applicable)
d. Commercial fishery (if applicable)
e. Resource assessment - is the fishery in danger of collapse?
f. What type of gear is used to catch the fish and an outline of the fishing methods?
g. Export options (if applicable)

Materials required (per group)

- copy of *Fisheries Resources*

  available from

  Google new address

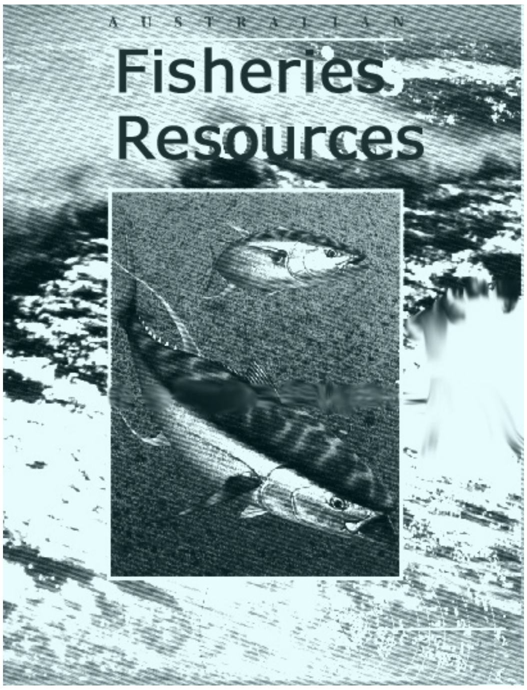


Figure 126.1 All you would ever want to know about Fisheries Resources

Figure 126.2 Australia, New Zealand, PNG and Timor

Extent of fishery for invertebrate

Extent of fishery for vertebrate

EXERCISE 127 CONSERVATION PRINCIPLES

CLASS DISCUSSION

Activity 1 Some principles

Read your textbook (pages 575 - 576) and write out a definition on the piece of butcher's paper of:

- Inter-generational equity
- Natural resources valued appropriately
- Dealing cautiously with uncertainty
- Taking a global perspective

Activity 2 Case study

Look at Figure 127.1 of Burleigh Headland. Three hundred years earlier, this land was covered with She Oaks and Melaleucas. A few Aboriginal people from the Gombemberri Tribe would gather and make their dwellings under the trees. When the Melaleucas flowered they would hunt mullet. Each generation left the next with ample resources to live.

1. How is this headland starting to change? Is this generation of coastal users giving any thought to the resources the next generation will need? Give reasons for your answer.
2. Is there inequity between generations? If so what is it?
3. In the 1990's, governments have had to allocate large sums of money to buying back coastal land and revegetating it with Melaleucas and She Oaks in land care programs. Why is this so and what industry relies on the natural beauty of our coastline.

Activity 3 Video

View the video, Beach Nourishment to the Rescue, from the Gold Coast City Council.

One member of your group is to tally up the amounts of sand pumped onto the beaches and another the costs involved.

Other members are to identify the problem and what methods were used to fix the damage.

Use *Coastal Studies* Pages 73 - 85 which summarises the video script.

1. Estimate the volume of sand in cubic metres that has had to be placed on the beaches on the Gold Coast. Now calculate the value of a naturally occurring beach at $3 per metre.
2. What do you understand by the term: Natural resources valued appropriately, and do you think that they have been valued appropriately in this case study?
3. When the Tweed River Walls were built, do you think coastal engineers knew the meaning of the term 'dealing cautiously with uncertainty'?
4. Figure 127.2 shows the mouth of the Nerang River in the City of the Gold Coast. A training wall has been built so boats can enter and leave the river safely. A dune system free of development has been left and a recreational surfing reserve established.

   Figure 127.2 shows a sand pumping system that collects sand on one side of the training walls and deposits it on the other.

   Does this system take into account the principle of dealing cautiously with uncertainty? Explain your answer.

Activity 4 A global perspective

Many businesses were developed on the Gold Coast in the 1960's and entrepreneurs developed resorts such as Marina Mirage and Sea World. Should these places be restricted to the Gold Coast or should we allow unrestricted development along our entire coastline?

1. In a global perspective, is there room for coastal developments such as the Gold Coast?
2. Make a drawing of your state's coastline. Now allocate places for development of the coast, identifying areas that should be preserved, conserved and developed.
3. How should world development occur? Should developing countries be allowed to develop their natural resources the way Australia has?

   Is there a role for ecotourism? Explain your answer.

MATERIALS AND EQUIPMENT (PER GROUP)

- Butchers paper and pen
- Video: Beach Nourishment to the rescue
  Beaches and Waterways Section
  Gold Coast City Council
  PO Box 5042 Gold Coast Mail Centre 9729
- Reference book: *Coastal Studies*
  Available from
  www.wetpaper.com.au
  Also in Marine Science for Australian Students

Thelma Moffatt

Figure 127.1 Burleigh Heads 1920's

Wet Paper

Figure 127.2 A sand by-pass system (Photo by the author)

EXERCISE 128 RIPARIAN HABITAT ASSESSMENT

QUESTIONS

Read Chapter 5 of the WaterWatch Queensland manual and answer the following questions.

1. What is the significance of the sign in Figure 128.1?
2. Mark in the following terms on Figure 128.2:
   - riparian zone
   - verge vegetation
   - floating vegetation
   - emergent vegetation
   - submerged vegetation
3. How could sea grass beds be affected by removal of the trees in Figure 128.2. Refer to the illustration in your answer.
4. If the trees were cut down to make a nice view for a coastal development, what effect would it have on coastal fauna?
5. What role does riparian vegetation play in the conservation of animal corridors?

MATERIALS AND EQUIPMENT (PER GROUP)

Reference materials

- a copy of Chapter 5 WaterWatch Queensland Technical Manual

  available from:
  WaterWatch Mailbag
  DPI Land Conservation
  Meiers Rd Indooroopilly 4068

- For your current WaterWatch Co-ordinator contact:
  The Australian Nature Conservation Agency
  GPO Box 636
  ACT Canberra 2600

FIELD WORK

1. Complete the habitat assessment sheets from Chapter 5 of the WaterWatch Queensland manual.
2. Find a marine reserve and if necessary obtain a permit to complete a vegetation study of an area which runs into a local creek or river.
3. Find out the names of local vegetation species and complete a vegetation transect and riparian assessment using the reference materials supplied.
4. Complete a ecological succession study for your local area using the transect method.

Wet Paper

Figure 128.1 The importance of our catchment

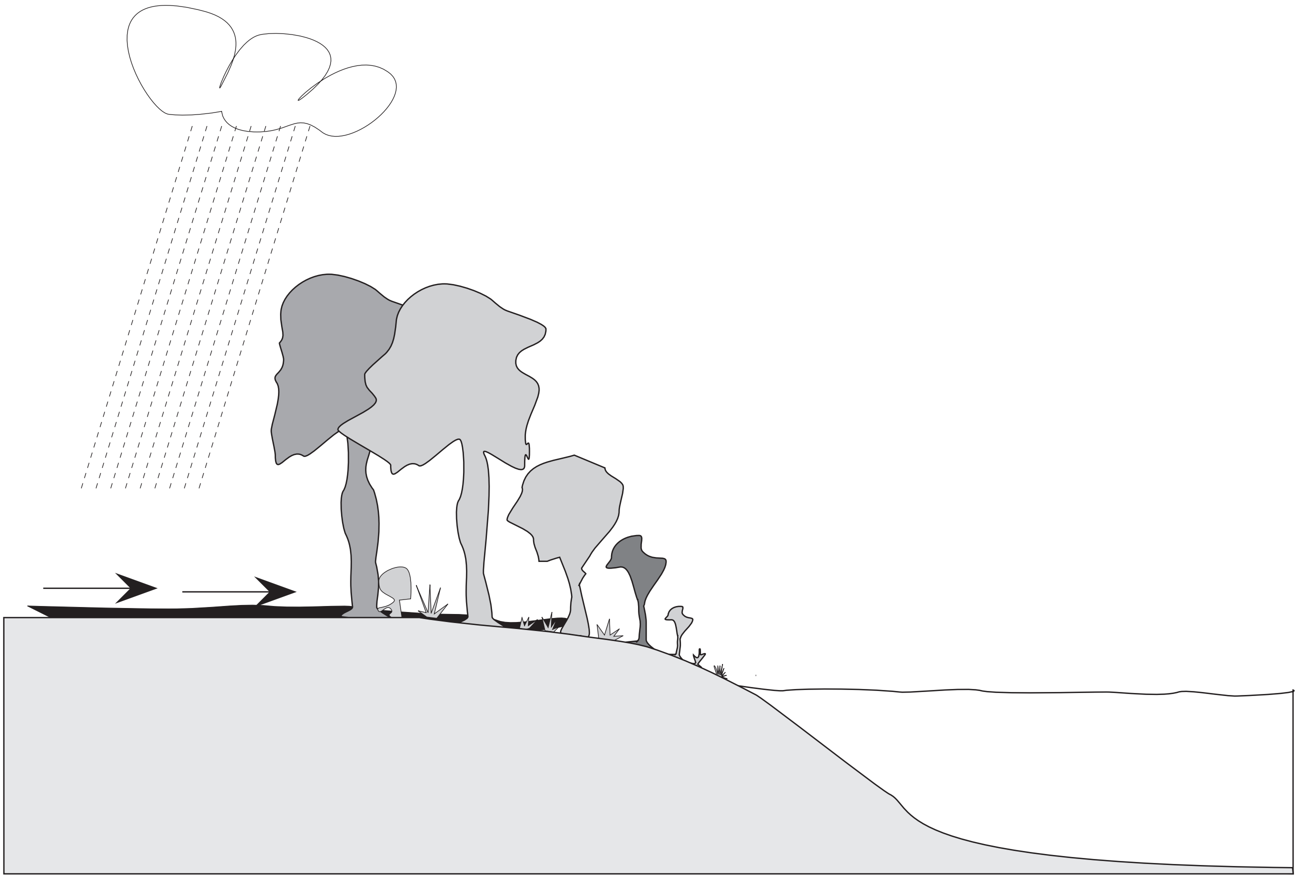


Figure 128.2 Estuarine creek cross section. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Wet Paper

Exercise 129
Water velocity in the catchment

Questions

1. Plot a graph in the space provided in Figure 129.1 to compare the stream flow rates for the two coastal creeks identified in Figure 129.1.
2. Mark on the graph the following observations:
   - great and earlier peak discharge
   - more runoff volume
   - rapid recession
   - smaller and less rapid peak
   - greater recession
   - increased base flow due to irrigation
3. Make up a table comparing the two creeks using the observations made in Question 2.
4. How does increased flow rate affect a coastal creek?
5. Oysters growing in a creek mouth have been tested and found to contain faecal coliform bacteria at levels 100 times permissible standards.

   What signs should a local authority put up and suggest why bacterial levels have increased.
6. Phosphate levels can be reduced by adding soaking drains to a creek's verge vegetation system.

   Can you suggest the purpose of these drains and why phosphate levels should be reduced in the creek.

Creek A Urban situation without riparian zone

Time in minutes	Stream flow rate metres/sec
2	0
4	0
6	0
8	0.5
10	1.0
12	2.7
14	6.9
16	19.2
18	14.3
20	12.1
22	8.1
24	6.1
26	4.5
28	2.3
30	2.1
32	2.3
34	3.4
36	2.1
38	1.4
40	1.4

Creek B Urban situation with riparian zone

Time in minutes	Stream flow rate metres/sec
2	0
4	0
6	0
8	0
10	0.2
12	0.4
14	1.1
16	3.5
18	3.1
20	2.1
22	1.1
24	0.5
26	0.5
28	0.4
30	0.2
32	0.2
34	0.0
36	0.0
38	0.0
40	0.0

Figure 129.1 Data from two creeks

Figure 129.2 Graph from two creeks

Wet Paper

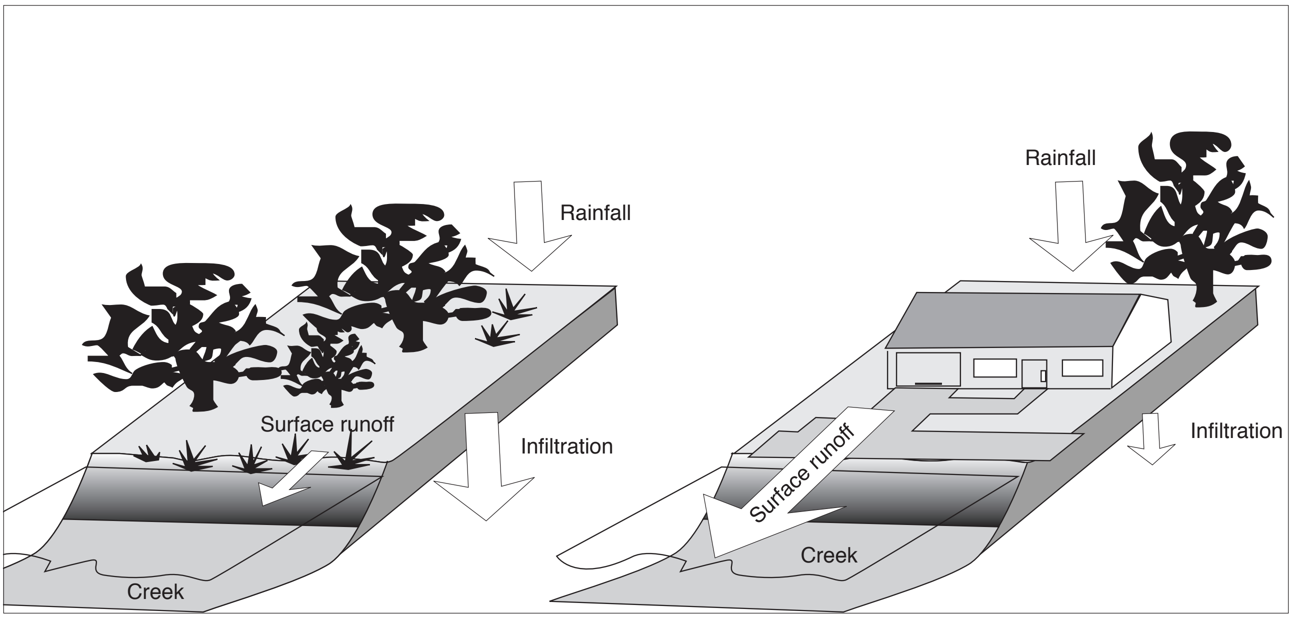


Figure 129.3 Comparison of two creek's riparian vegetation. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Wet Paper

Exercise 130 Sourcing litter pollution

Method

1. Select a sample site for the collection of litter from a stormwater drain or creek.
2. Using rubber gloves collect all the litter that has accumulated.
3. Sort this out on a clear piece of ground and do a count of the litter that has been collected.
4. Group the data so that a percentage estimate can be reached by either of the following methods:

- **The number of items method**

  Suppose you have sorted the litter out into six large groups.

  If there are 100 cigarette butts, 30 plastic bags, 35 drinking straws, 6 coke cans and 2 PET bottles – add up the data and present its shown in Table 1.

  Now draw graphs to show your data.

- **The rough volume method for litter analysis**

  The volume method involves stuffing the litter into bags and arranging the bags as close to each other as possible.

  The entire area of bags = 100%

  By inspection and with group consensus, assign a percentage value to each of the bags as shown in Table 2.

Table 1

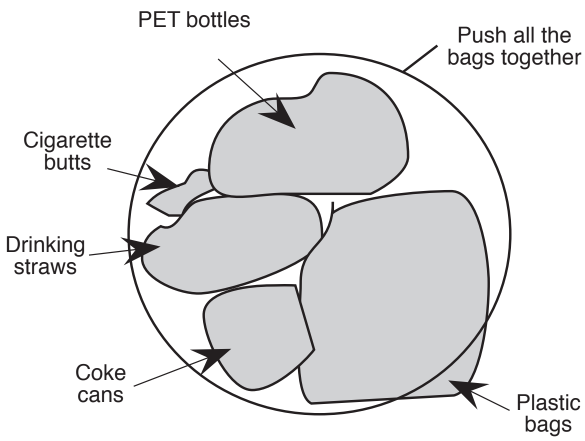
Litter analysis by number of items collected

Type of litter	No	Percentage
Cigarette butts	100	57.80%
Plastic bags	30	17.34%
Drinking straws	35	20.23%
Coke cans	6	3.47%
PET bottles	2	1.16%
Total	173	100

Table 2

Litter analysis by bag volume

Type of litter	No	Volume Percentage
Cigarette butts	100	5%
Plastic bags	30	50%
Drinking straws	35	20%
Coke cans	6	15%
PET bottles	2	10%
Total	173	100



Wet Paper

Figure 130.1 Estimate method for litter analysis

Wet Paper

Figure 130.2 Students from Innisfail SHS sourcing litter (Photograph courtesy Geoff Jensen)

EXERCISE 131
CONFLICTS

Based on original exercises by Bob Moffatt and Tim Ryan

ESSAYS

Write an essay on one of the following topics depicted in Figures 131.1 or 131.2

Either

The *Australis humanii* as shown in Figure 131.1, is a quiet and sociable bird. It loves to collect many different objects. Here it can be seen on its nest.

1. Write a 300 word essay on the image this cartoon portrays.
2. Suggest some other characteristics of *Australis humanii*.
3. Comment on the future of *Australis humanii*.
4. Make a list of suggestions that might improve the future of this species.

or

Study carefully all the people and images portrayed in Figure 131.2. Now write a 300 word essay of what you perceive to be the conflict arising from the relationship between community desires to preserve and use marine ecosystems.

The building blocks of modern society

Figure 131.1 *Australis humanii*

Figure 131.2 Stimulus photograph (Photo courtesy of the Surfrider Foundation. To join this association you can write www.surfrider.org.au

Exercise 132
Dilemma
exercise

Questions

The following is a list of values about the coast.

1. Use your textbook to complete the sentences:

    a. Going to the beach is ...

    b. The coast provides so many resources that there ...

    c. Water is ... property and ...

    d. The government and the local authority have ...

    e. We should all ...

    f. Freedom of action is ...

    g. If you have to pay to go anywhere like the beach, then that is ...

    h. I know what to do to ...

    i. Beauty is in the ...

2. Do you wish to add any more sentences to this theme?

3. Look at Figure 132.1 Suppose someone locates what appears to be an Aboriginal midden (an old feasting place) on one of the dunes close to the beach. Lots of shell remnants indicate the site. A group of surfers report these details to the local Shire Council who then has to decide what to do.

    If the midden is fenced off from public access, and a notice put up saying "Keep Off", the site is quite likely to be vandalised. If nothing is done to identify the site, other people may destroy it by running over it, or digging it up.

    So what do you think should happen?

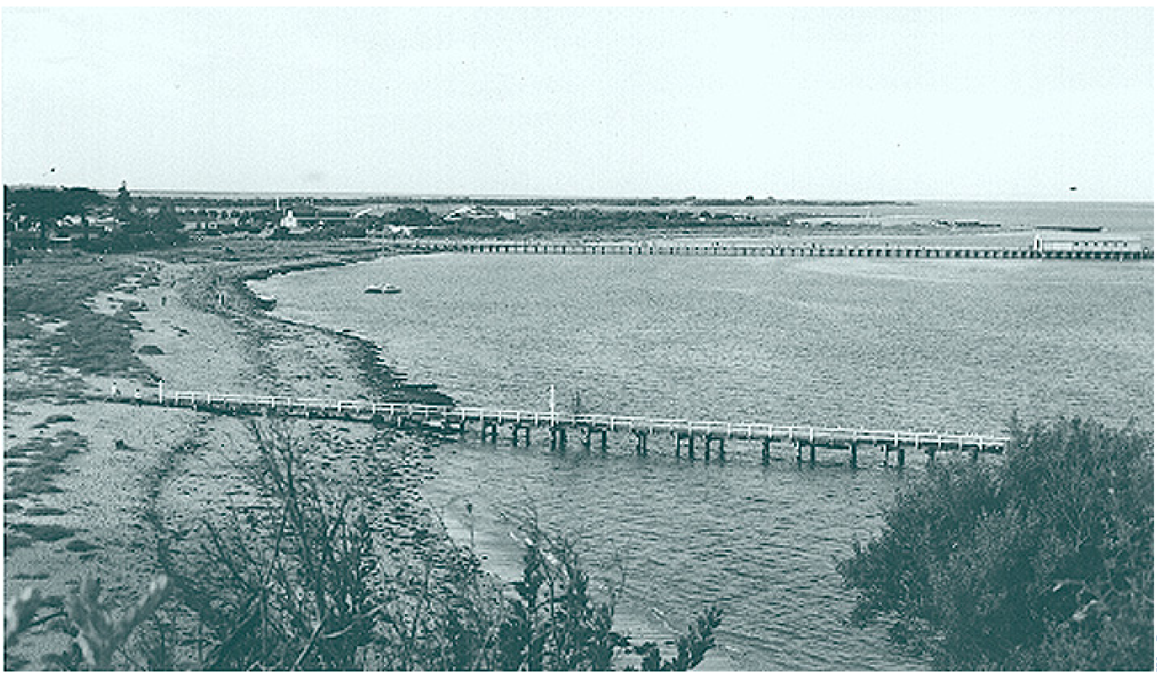
4. Look at Figure 132.2. The jetty is becoming littered with rubbish by fishers who use the jetty. Bait bags, empty bottles, fish guts, hooks, broken pieces of fishing line become entangled in the jetty and wash up on the surrounding beaches.

    If the jetty is closed, then the people who fish who don't rubbish will loose a valuable recreation. If a fee is charged, people who rely on the fish for food will be deprived. If the rubbish is allowed to continue, the tourism in the town will suffer.

    What do you suggest?

Wet Paper

Figure 132.1 Somewhere on the coast of Australia



Wet Paper

Figure 132.2 Somewhere in Victoria

EXERCISE 133 WRITING A NEWSPAPER ARTICLE

Based on an original exercise by Tim Ryan, Maryborough State High School.

METHOD

1. Read the information in the boxed section in Figure 133.1.
2. Now use this structure to write a newspaper article or letter to your local member of parliament on a local management or conservation issue.

   The article or letter needs to discuss possible conflicts that arise from the relationships between community desires to preserve and use marine systems.
3. If you are hand-writing the article use the space on page 289 and make a sketch of a photograph that may accompany the article.
4. You may need to research the event fully before writing the article.

Newspaper articles

The purpose of a newspaper article is to inform. It is not a simple list of facts or a record of the event.

Structure of a newspaper article

a. Headline
   - attention grabbing (eye catching)
   - abbreviated

b. Lead-paragraph
   - readers like essential information first, to gauge whether they want to read further.
   - brief information such as who, what, when and where
   - introduction

c. Body
   - more details of the event
   - can mention similar events
   - may use quotes to add interest and human factor

d. Sources
   - comments by people involved
   - expert comment

e. Format
   - photographs, maps, sketches may be incorporated to support or add meaning to the story
   - usually 25 word lead paragraph and 30 word paragraphs. When in columns information becomes dense if paragraph is too long

Letter to local member of parliament

Dear ...

Have you been to the beach lately? As someone who derives great pleasure, not to mention indirect income, from the coast, I write to ask that you give its future and mine, your earliest attention and highest priority.

Seriously, this national treasure could become a national disaster if current management practices continue. I am fed up with the quality of my coastal environment deteriorating and call on your government to act upon the major recommendations of the Resource Assessment Commission's Coastal Zone Inquiry.

That includes a get tough approach to polluters, the phasing out of ocean outfalls polluting our surfing beaches and the indiscriminate development of the coastline which will affect the quality of life for generations to come.

The Mariner City Conservation Foundation represents my interests and also those of most of the fourteen million other Australians who live on and love the beach.

I would like you to work more closely with the Mariner City Conservation Foundation on policy, legislation and management of the coast. Your government should also make a substantial grant to the Foundation to allow it to operate fully.

I look forward to your response to these requests and am very interested to learn of your plans to seriously address this critical issue.

Yours faithfully

Figure 133.1

Figure 133.2 Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet

Exercise 134 Future problem solving

Based on an original exercise by Gwen Connolly.

Method

1. In order to extract, enhance and organise information, we need a strategy which connects analysing and synthesising with the grammatical functions.

   A framework such as 5W+H will allow the access we need to any piece of writing. It will also stimulate further questioning and a flow-on of ideas.

2. Select a case study from Figure 134.1.

   Then divide your class into 6 groups and call the groups Who, What, When, Where, Why and How. Label each group's piece of butcher's paper in the same manner.

3. Now read the case study you selected. In reading the case study, you must be able to extract the facts and then organise them so as to truly evaluate the study's worth. This activity will show you how this can be done.

4. Select a piece of butcher's paper for your group.

   It will be labelled either; Who?, What?, When?, Where? or How?

   Brainstorm the problems in the case study and identify the problem by writing a sentence in the following format.

   Complete the statement — A person/s may/could be acting in a particular way at a particular time and place because ________

5. The underlying problem now needs to be identified and expressed as a How question.

   How can we (do something) so that (a result will be achieved) with (a person or group at a certain time and place?)

   Now brainstorm the solutions.

   (Say who should do it, what will be done, how, when and where.)

   In order to synthesise the best solution, all the solutions need to be evaluated using the same criteria. A criteria grid could be developed here to visually see which solution 'wins'. Now express this solution in the following manner: (who will do it, what will be done, how, when and where.)

Case studies

Consider the following case studies, all of which have occurred in Australia in the past year or so. Each could form the basis of a separate problem solving exercise or class discussion. First, state the problem in each case.

Then decide: If you were the Local Government Council involved, how would you have proceeded? Again, if you were the State 'Co-ordination' Committee, how do you think the situation would have been resolved? Finally, suggest a solution or alternative which would reduce the impact on the coastal environment. (You may need to consult newspaper files for more details.)

1. The fishing people in Tasmania are demanding compensation for their fishing catch as it has been condemned for sale several times between 1990-91 with high levels of mercury. The estuary of the River Derwent, downstream from Hobart, is suspected as the source of the mercury. Who should pay the compensation, if any?

2. Early in 1990, oyster sales from the oyster beds in the Hawkesbury River, north of Sydney, were stopped because of contamination of the oysters by sewage discharged from nearby settlements. Who should pay for the water to be cleaned up?

3. The fish on Brewer Reef off Townsville got so used to being hand fed by tourists visiting the Floating Hotel that they still hang round waiting, over a year after the hotel has been removed. If fish become so conditioned to humans, should fish feeding by tourists in Queensland, and the rest of Australia be banned?

4. Two Taiwanese trawlers were apprehended off the Reef and bought into Cairns (Queensland) Harbour to face charges relating to their large, illegal catches of clam meat and trochus shell. Local fishing people and tourist operators are furious as they know more trawlers are getting away without being caught. They are demanding more patrol boats, more surveillance. Residents and conservationists are most concerned at a new proposal to increase the number of radar facilities which would assist in the surveillance of such boats, because these often have to be put on headlands in sensitive coastal National Parks. What should happen?

5. In November and December 1991, a toxic algal bloom extended through the Murray-Darling system, threatening the fish and scallop industries of the lower Murray River in South Australia, and the stock and townships all the way down river who used the Darling and its tributaries as drinking supplies. The algae was blamed on the increase in nutrient levels coming from sewage discharges from over 140 sewage works, and run off of fertilizers from farms along the river in Queensland and NSW.

   Flood rains in mid-December flushed much of the system, but the farmers want to know: Who pays for the drinking water they had to buy when they and their stock could not use the river water? Will the bloom occur again?

6. In July 1991, a Greek oil tanker, “Kirki’, spilled more than 23 million litres of crude oil into the ocean off Western Australia, threatening the spectacular reef system and the local island and mainland beaches, sea birds, fish and seals. A massive clean up operation involving chemicals, booms, and physically picking up the oil only succeeded because of unusually calm conditions. How can such environmental disasters be avoided?

7. Late in 1991, the Commonwealth announced that, to booster the economy and employment situation, it was ‘fast-tracking’ the proposed extensions to Sydney airport and that the third runway would be built into Botany Bay without waiting for the results of the environmental impact assessment. The runway will intrude into wetlands and the last remaining area of undisturbed land in Botany Bay.

8. Magnetic Island, off Townsville in Queensland, is the site at Nelly Bay of an abandoned multi-million ‘reef city’ of hotels, residences, and shops. The company involved (Interwest Holiday Group, financed by Tricontinental, and the State Bank of Victoria) was given approval to clear a headland, bury a famous beach and reef, and blast rock. Half way through the project, following long and costly legal proceedings by local conservationists, the company and its financiers collapsed. The promised bond of $20 million to rehabilitate the land was not lodged with the Great Barrier Reef Marine Park Authority in whose area the development had been given permission to proceed. Who should now be responsible for returning the area to its once pristine state?

All of these cases require compromise, discussion, agreement between competing users and those concerned with management and preservation of the coast if any reasonable solution is to be found.

Obviously, one overall policy would greatly assist in the better preservation and use of our coastlines. Such a policy needs certain guidelines, or accepted principles, to make it appropriate.

Figure 134.1 Some case studies from your textbook.

Exercise 135 Venetian Island

Based on an original activity by Jan Oliver.

Do the *objectives* allow for the development of a new mineral resource along the coast? For example, what guidelines would be applied if a mining company wanted to extract manganese nodules from the continental shelf outside the Great Barrier Reef Marine Park?

These objectives and their guidelines take into account many of the problems affecting coastal areas around Australia.

Use this study to decide the answer to this question: Have the proposed **guidelines** and objectives been followed in this proposal?

Questions

1. Turn to your textbook Page 579 and locate the article on Venetian Island. Now answer the following questions.
   a. Where is the site? What is the natural environment?
   b. What is proposed?
   c. Who by? Who are the interested parties? Who is the intended clientele?
   d. How is the theme of a Mediterranean style resort being implemented?
   e. How is the natural environment being protected?
   f. How are the draft objectives from the green paper being followed (as far as you can tell)?
   g. Sum up what you consider are the good planning procedures which have been followed in this proposal.
2. Investigate your local newspaper files to see if you can find out about other such proposals in the coastal area near where you live. Compare these with the Venetian Island example.
3. Study the ACC proposals as outlined in Figure 135.1 and answer the following questions:
   a. What is the difference between a 'strategy' and a 'plan'?
   b. Go through each of the points from the Conservation Council and suggest why those points would have been made.
   c. What is meant by the phrase 'conservation is seen as a legitimate and significant use in its own right' ?
   d. Are the conservationists' demands met by the proposed strategy?
   e. What other features do you think should be included?

Australian Conservation Council

One of the organisations representing many conservation groups, the Australian Conservation Council had already put forward its proposals for sustainable coastal management.

Proposals

1. Increased research. There is a lack of inventories of coastal habitats which prevent informed decisions being made. Little research has been done on the long term effects of sand mining, impacts of offshore sewage disposal, or of canal estate development or of industrial outflows (e.g. from sugar mills) over long periods of time.
2. Establish a planned and balanced forward thinking approach implementing the numerous recommendations from previous studies, some of which have cost a fortune and whose recommendations have been ignored by the state government of the time. Community participation is essential and should be on-going.
3. Establish a better system for setting up coastal reserves. Priority should be given to completing inventory work in sensitive areas (coastal dunes, wetlands and rainforest) or those under threat from proposed developments, so that conservation is seen as a legitimate and significant use in its own right. Reserved areas should not be places no one else wants!
4. Improve impact assessment of proposals, insisting on experts and trained personnel, so that unsound decisions will be avoided.
5. Provide advice and expertise to local government authorities who have to make the final decisions. Regional land use plans are needed so that all developments are seen in perspective. Some proposals have to occur, but should not have long term bad effects on the coastal environment.

Figure 135.1 ACC 1991 proposals (from your textbook)

Exercise 136 Tweed River Walls

Based on an original exercise by Gwen Connolly.

Method

1. The following words are called signal words and are commonly used in a cause and effect statement.

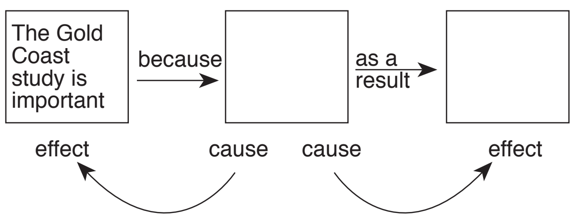
Cause	Effect
because, since	therefore, then
owing to, if	as a result
in order to	so, thus
for the purpose of	the effects
this is why	the result
the reason for	in response to this
the explanation is	the consequence was
this led to	what followed was
affects	results in
alters	is the product of
changes	led to
produces	

2. To obtain practice at using these words, read this paragraph and underline the cause-effect signal words.

   The Gold Coast study is important because it raised Australian level of knowledge of coastal processes.

   As a result, today, coastal management is given high priority by Local, State and Federal governments.

3. Now complete this box to test your understanding. If you have problems, ask your teacher.

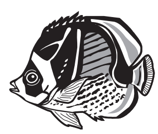


4. Collect a copy of the book, Coastal Studies, and read pages 73 to 88. Then complete the worksheet in Figure 136.1.

Materials Required

- reference book *Coastal Studies by Bob Moffatt*

  Available from:
  Wet Paper Publications
  14 Milbong Tce
  Ashmore 4214
  Fascimile (07) 55 394187



Worksheet

1. Complete the figure below giving the cause and effect of some of the events that followed the building of the Tweed River training walls.

	CAUSE		EFFECT
1.	The building of the Tweed River training walls	resulted in →	accumulation of ____________
2.	The accumulation of sand on the southern side of the training walls	led to →	a defecit ____________
3.	The defecit of sand moving around Point Danger was	followed by →	the destruction of ____________
4.	Without the ____________	altered →	the angle at which the waves broke onto the beach
5.	Massive erosion soon followed	since →	the waves ____________

2. What are the missing words in the following statements:

   a. The Tweed River mouth moved northwards __(i)__ sand from the longshore drift formed a spit. __(ii)__the Tweed River now enters the sea just south of Point Danger.

   b. The Tweed Bar is very dangerous __(iii)__ the development of Letitia Spit. __(iv)__this the NSW Government built training walls.

3. Write sentences using cause and effect statements on the following:

   a. Kirra Point groyne

   b. Kirra groyne

   c. The sand nourishment program of 1974

   d. Sausage groyne at North Kirra

   e. The Vlaanderon XX operation

   f. The beach nourishment program

3. Complete two sentences on the effect of building the Tweed River training walls. Complete the sentences with the outcome as we see it today and the options for the future.

Figure 136.1 Cause and effect

Exercise 137 Managers and user groups

Based on an original exercise by Tim Ryan, Maryborough State High School.

Questions

1. Figure 137.1 shows a generalised diagram of how fish is distributed in the United Kingdom.

   Although the Australian fishing industry has developed in a very different way the industry in the U.K. from such as shorter distances, no long distance offshore fleet, no state versus commonwealth legislation, and different types of fisheries there are also many similarities.

   Draw up a generalised diagram for the Australian fisheries.

2. The U.K. fisheries have a number of problems such as over fishing, competition from imports, problems of enforcing regulations and conflicts with other fishing nations.

   Do Australia's fisheries have similar problems?

   Support your answer with examples.

3. The U.K. fishers have seen continuing cost increase and this has seen the industry focus on ways to further reduce costs in areas of catching, processing, storage and distribution.

   Suggest some ways of reducing costs.

4. Outline the effect of some of the cost reduction methods on the community e.g. many may have technology replacing the labour force.

   What social problems may unemployment cause?

5. How can better marketing of the produce increase rewards to the fishing industry?

   How could we improve the marketing of the catch and who should do the research to improve the marketing? Who should pay for the research?

Extension questions

1. Research the library to provide information on the control of Australian fisheries.

2. Draw a flow diagram to show this control. Do you believe this control is necessary?

   Suggest improvements to existing legislation in Australia.

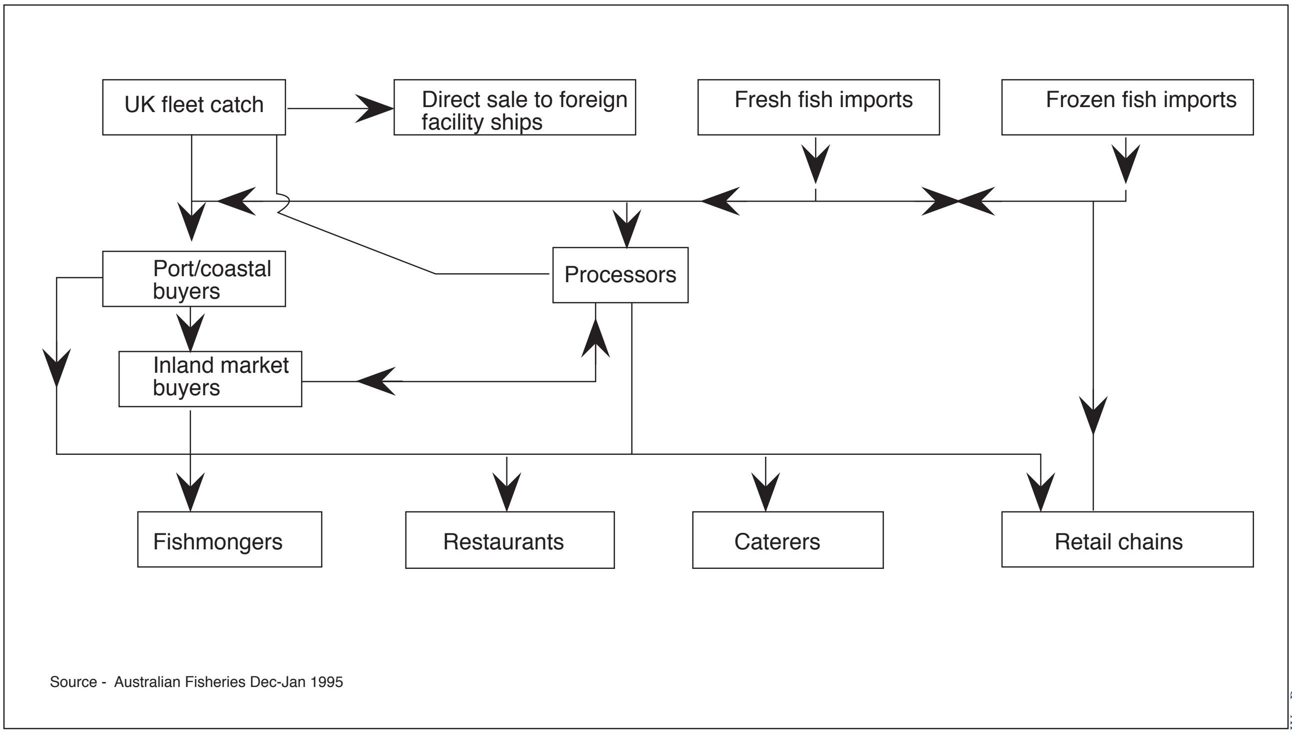


Figure 137.1 Generalised diagram of United Kingdom fish distribution

Figure 137.2 Generalised diagram of Australian fish distribution. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 138 Management proposals

Based on an original exercise by Tim Ryan, Maryborough State High School.

Questions

1. Complete the speech bubble for Figure 138.1 using the theme that there are management proposals in place but a fish kill has still occurred.
2. Complete the table in Figure 138.2.

Optional extensions

1. Produce your own cartoon which may explain an aspect of management and conservation. The cartoon should be of a standard that could be used in the school newsletter or local paper.
2. Produce a comic strip suitable for a Grade 1-3 primary school student that gives them an insight into the problems facing the sea.
3. "*How I love the velvet blue,*

   the dawning of the sun.

   On glistening tropical waters

   it makes my heart go calm."

   Compose a song or poem to highlight your interest in the sea.
4. Design a word puzzle or crossword which contains many of the important terms used in the study of management and conservation.
5. Create a board game that could be played to demonstrate the problems faced in the management and conservation of the sea. It should be interesting to play and have an element of fun in it.
6. Design your own poster on the theme, 'Interrelationships between marine organisms and habitats'.
7. Attempt to write a short play on the theme, 'Conservation of the Sea'.

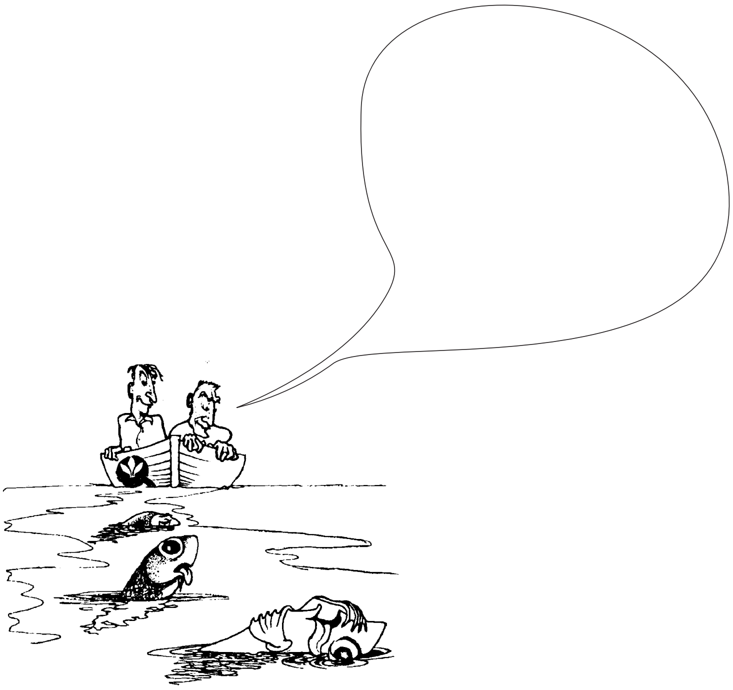


Figure 138.1 Fill in the speech bubble

Management proposal	Possible reason behind proposal
Bag limit on fish	
Limit development to 10 km inland of coastline	
Convert all sewage to tertiary treatment and pump inland to be used in industry and new housing development	
Establish marine protected areas along entire coast of Australia	

Figure 138.2 Management proposals and the reasons behind them

Exercise 139 Hypothetical Bay 2010

Questions

Read the boxed section in the next column, study the information in Figures 139.1 and 139.2 and answer the questions below.

1. Make a comparison of Figures 139.1 and 139.2 and describe at least 20 changes that are proposed.
2. Why did the regional government ban all development along the coastline from Steggles Beach Reserve to Farmer Beach?
3. Is it a good idea to have all the sewerage effluent from the city pumped out into the ocean at King Point?

   What could be done with the sewerage?
4. What effect will an international airport have on the proposed Slaughter National Park?
5. If Fishers Wharf is planned, what will be the effect on the township of Holthouse Flats?
6. Massive ecotourism is set to develop in the Bay. The reefs off Steggles Beach reserve are pristine and need management.
   - What zoning or management proposals do you suggest?
   - How will you go about zoning the reef?
   - What is your vision for the reef 25 years after you draw up these management plans?
7. How will the freeway affect Mariner City?
8. How do you feel about an exclusive resort being developed in Lynch River? If the resort went ahead, what types of access do you think the general public would have to the resort?
9. Will Perry Shoals suffer from increased use and will the whole of Hypothetical Bay have to be zoned?
10. Propose a management plan for Hypothetical Bay in Figure 139.2.

Class Report

1. Divide the class into nine groups.
2. Make a copy of Figure 139.3 cut the outside nine boxes up and place in a hat. Each group elects a leader who selects a topic.
3. Discuss the topic for ten minutes, make notes, elect a spokesperson and deliver a three minute summary on your notes.

Read this

Tourism is one of Hypothetical Bay's fastest growing industries with many people escaping the cold winter in the northern hemisphere to bathe in its crystal clear waters.

Steggles Beach was voted beach of the year's in 1995 and has unparalleled attractions at the nearby Collins, Redden and McDonald Reefs. Watson Bay National Park is well renowned for its coastal flora and fauna including the world famous Smith Parrot.

In the 1960's Hypothetical Bay was a sleepy hollow and developed in the 70's and 80's to a stage as shown in Figure 139.2.

In the 1990's Lynch River was dredged with the approval of a new marina south of Batestown.

A proposal is before the Batestown city council for a mega city and development. It is proposed to widen Bade Creek and build a Fishers Wharf complex that will link Watson Bay by a causeway.

Watson Swamp will be dredged to create a massive foreshore development around the new Mariner City with an international airport that will take five flights from Japan each day.

The Regional Government has proclaimed that the entire foreshore from Steggles Beach be a reserve and to include Butler Beach to Farmer Beach and the Plattern Reserve.

The headland to the east of the airport is to be a national park and the sacred aboriginal sites to be managed by the local Warranda tribe and a permit to enter the national park will have to be obtained.

A new breakwater is proposed as well as an artificial island offshore, the details of which are not disclosed.

To the west of Lynch River is a Harbour Town development for an expected 70,000 people and a exclusive resort opposite Wright Point is planned along the Club Med style.

A secondary sewage system is planned to discharge at King point on the new breakwater, much to the disgust of local environment groups who have taken the council to the environment court and delayed the plans.

The regional government is keen to see the proposals go ahead as they plan to develop a freeway past Schmidts Hill to the new city.

The total cost of the project is 100 billion dollars and is financed by a Japanese consortium of companies. It is the brainchild of a developer living off the coast of southern Europe.

An election is imminent with one party saying it will scrap the entire development while the other is saying it will study the proposals carefully.

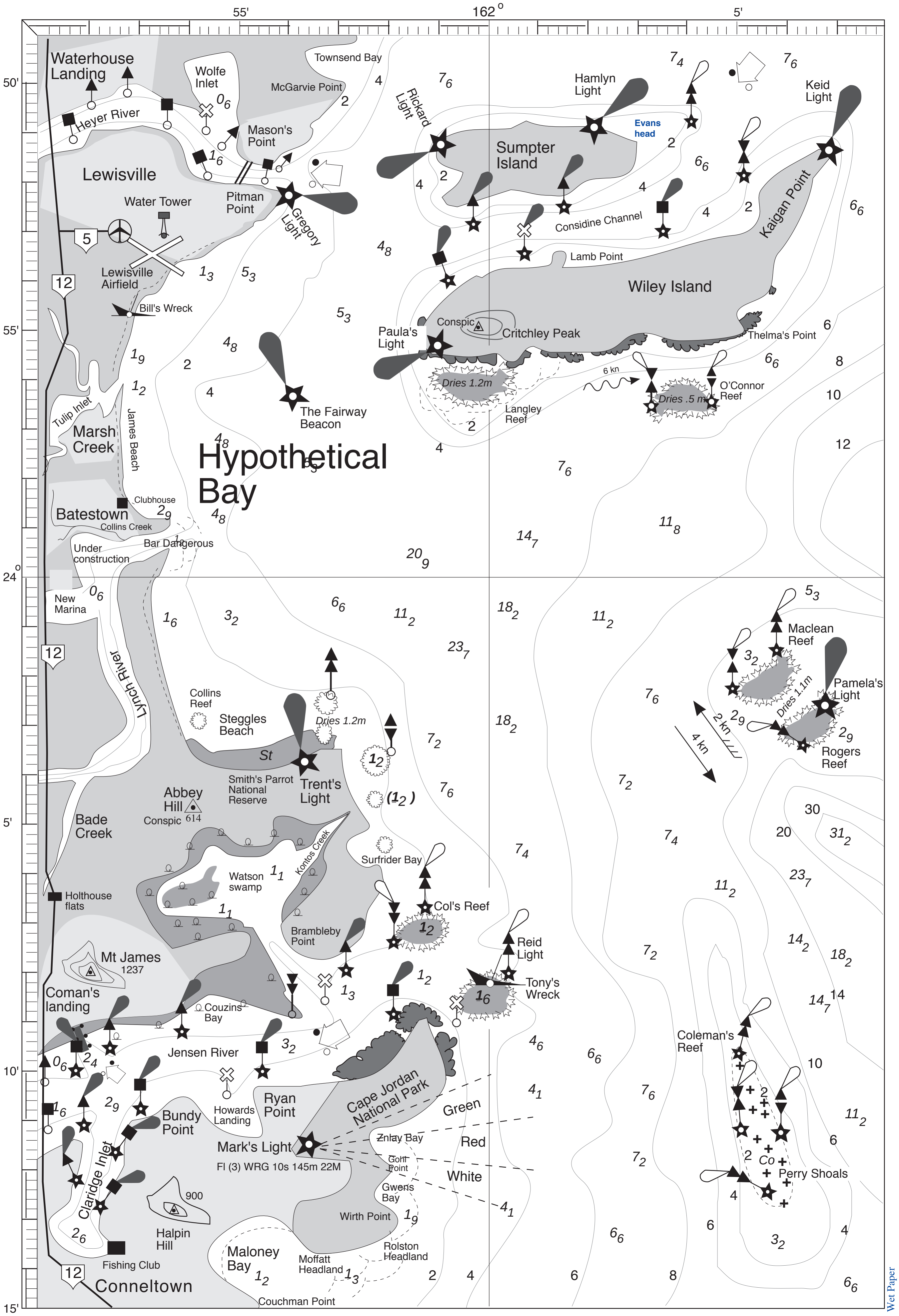


Figure 139.1 Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet.

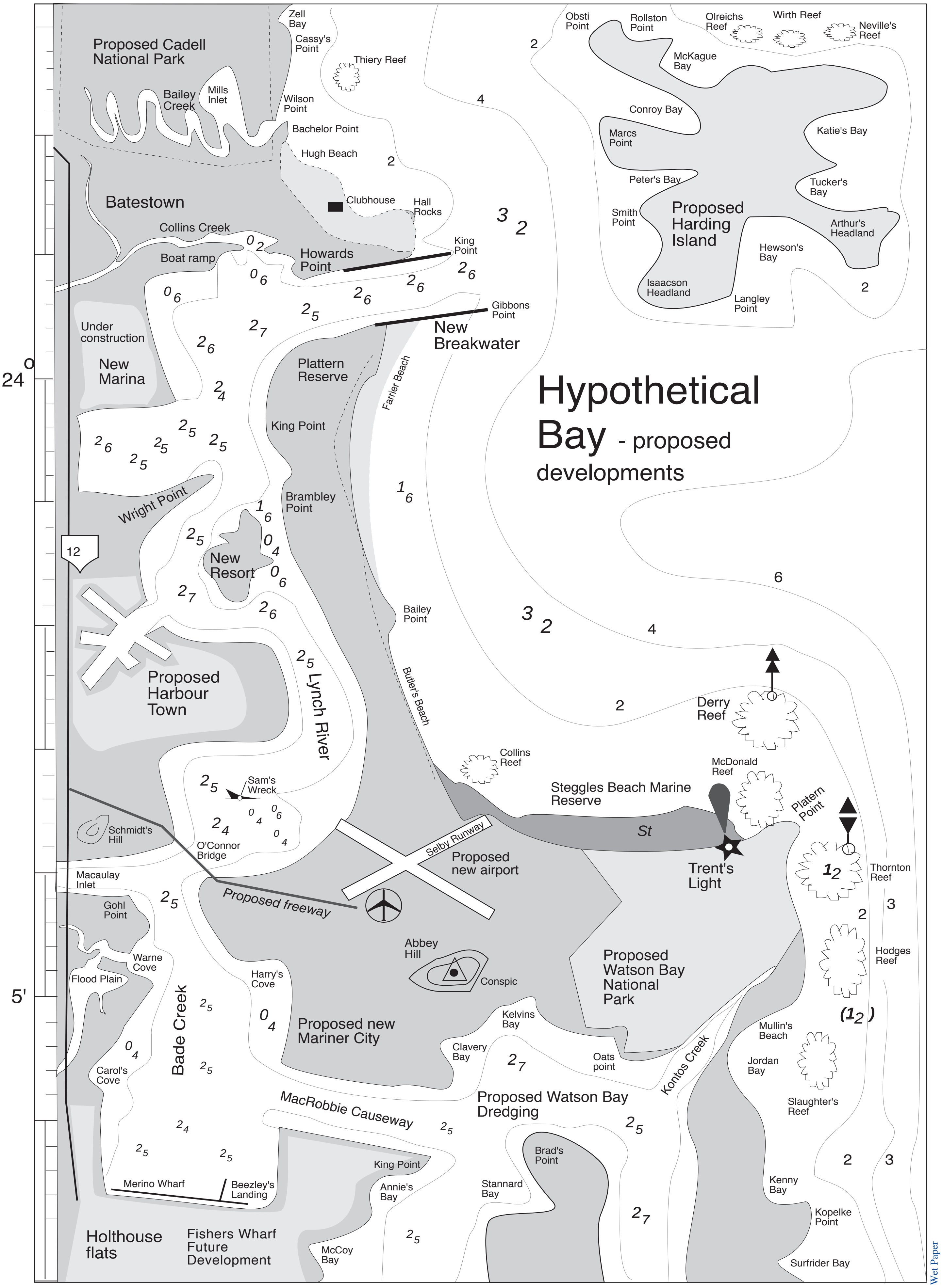


Figure 139.2 Students may make one copy of this page so that they can attach their answers before handing in for marking.

A new resort complex is being planned for Howard's Point at the mouth of Lynch River in Hypothetical Bay.

Two training walls are proposed to stabilize the river mouth.

Research the relevant legislation regulations that control this type of development in your state

In a group size of 3-4, brainstorm a list of benefits this resort may have for the area

Design a survey that might gauge the community reaction to the new resort.

Predict some of the possible environmental consequences of the resort

Debate the topic — Howard's Point Resort should not go ahead

Construct a scale model of the resort structure

What will be the effect the training walls on the 500,00 cubic meters of sand that move north each year?

Outline some of the research that may be required to determine the water quality of the river. What will be the effect of the new training walls on the hydrography of the river? Will existing sand banks move? Will more mosquitos breed? Will existing jetties have to be moved or dredged around them?

Complete a poster title: Environment v's coastal development, or prepare a debate: Pollution is caused by the smell of money

Figure 139.3 Proposed activities. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 140 Controversy at Hypothetical Bay?

The year is now 2010 and the redevelopment of Hypothetical Bay has gone ahead. The following are newspaper articles extracted from the Mariner City News.

Method

1. Read each article carefully.
2. For each article, write down the main environmental issue.
3. Write down the names of the people mentioned in the article and the organisations, government agencies or groups they represent.
4. Count up the number of points made in the article to see if the article is balanced. You might like to score each paragraph or just give an overall impression. The most important thing is to form an opinion and explain why you came to that conclusion.

Article 1

Robertson to discuss sewerage at Hall Rocks

Environment Minister, Mary Robertson, will announce at Hall Rocks today preliminary results of a statewide review of sewerage treatment plants.

A spokesman revealed yesterday the survey began several months ago, and addressed Mrs. Robertson's concerns about a number of the state's sewerage treatment plants.

But he said that until the review was complete no single area or authority would be specifically identified.

"There may be a number of prosecutions initiated and we don't wish to prejudice our legal position," he said.

The Minister's announcement coincides with her opening of a special 'effluent' seminar at the Hall Rocks Bicentennial Hall, and follows allegations from the Surfrider Foundation that only one in five Hypothetical Bay councils complied with government discharge licenses.

Surfrider Foundation director, Brad Smith, said Collins Creek, Hall Rocks and Watson Bay councils were among a number of Hypothetical Bay councils short listed by the group for assessment for possible breaches of effluent discharge standards.

He said actions of these councils would be investigated by independent assessors, an inquiry prompted by reports to the foundation, independent and "green" groups throughout the state.

The foundation's reports claimed some councils had been operating without licenses at times, and had exceeded license standards regularly.

Today's effluent meeting begins at 9 am and the public is encouraged to attend.

Article 2

MOST FALL FOUL OF SEWAGE ACT

AS few as one in 10 sewage plants are believed to comply with licencing conditions, the Department of Environment and Heritage has found.

Local councils, however, claim they have a clean slate.

Harbour Town environmental officer Len Anderson said that under the Clean Waters Act the local councils had to submit effluent test results to the department.

"Mariner City and Harbour Town Shires have spent millions of dollars upgrading their sewage treatment systems and there is certainly no problem with them," Mr. Anderson said.

But an environmental leader warned that the pressure of population growth in the area could limit the council's abilities to continue to cope.

Surfrider Foundation national executive director Brad Smith yesterday called on Harbour Town Shire to hold a waste management crisis summit.

Environmental Minister Mary Robertson, speaking at a Hall Rocks seminar, said that the ability of most of Hypothetical Bay's sewage treatment plants to comply with their licence conditions was 'poor'.

In January, she ordered a performance review of Hypothetical Bay's sewage treatment plants 'to ensure that every sewage plant in Hypothetical Bay complies with the discharge standards stated in their licences'.

So far the review has shown that nearly 10 per cent of the licensees had no monitoring program in place.

"Compliance with all the quality and quantity parameters which are supposed to be monitored is relatively rare and is probably achieved by less than 10 per cent of licensees," Ms. Robertson said.

The Minister said she had written to the Local Government Association of Hypothetical Bay in April about the results.

Concern

"I said the matter was a grave cause for concern and could not be allowed to continue", she said.

Hypothetical Bay Greens' convenor Drew Ham yesterday criticised individual councils for a 'lack of motivation' to ensure they complied with the Act and the State Government for 'a lack of enforcement'.

He said that the State Government had not monitored compliance through random checks and there was no motivation for councils to comply.

While Mrs. Robertson declined to name individual councils because of possible legal action, Mr. Ham said there were concerns on the Sunshine Coast and in Townsville and Cairns.

Article 3

CESSPOOL FEAR IN LYNCH RIVER

A Mariner City environmentalist claims Lynch River is becoming a cesspool, and could pose serious health risks for swimmers and aquatic sports enthusiasts.

And he has attacked the State Government for failing to monitor water quality in the area.

Brad Smith, president of the Hypothetical Bay Surfriders Foundation, says the danger of infection is far greater than shark attacks, but does not attract the same publicity.

"Research has shown the water's faecal coliform count is well above accepted world health standards," said Mr. Smith.

He said anyone who immersed their head in the polluted water was running a risk of contracting infections, including those affecting delicate areas like the eyes, ears, nose and throat.

"This embraces sports like swimming, water ski-ing, jet ski-ing and windsurfing," said Mr. Smith.

Mr. Smith said it was six years since the State Government had done an official study on the purity of Lynch River.

Since then it had become the catchment area for stormwater runoffs from thousands of Mariner City waterfront homes, and the dumping ground for waste and sewage from even more boats, due to subsequent marina extensions.

"Lynch River is being turned into a cesspool while the Government stands idly by," he said.

The Surfriders Foundation has appealed to Broadwater MP Alan Grim to support water quality tests by Mariner University, and help persuade the Government to force boaties to have coloured dyes in their holding tanks to pinpoint any illegal pumping out of waste.

"At the moment it's open slather for polluters and we should be taking measures similar to the ones used so successfully in Florida where such things are mandatory," said Mr. Smith.

Mr. Grim said there was no question it was time for action on the points Mr. Smith raised.

"Lynch River is too precious to pollute, and I am happy to support any study which yields information, but some solutions are available already," he said.

Mr. Grim said the State Government should legislate 'urgently' to include sewage pumpouts in all new boats over seven metres.

He said while there was merit in the proposal to dye the waste released from boat holding tanks, caution had to be exercised in view of United States reports which claimed the dyes polluted the water more than the original problem.

"More research can help pinpoint sources of pollution," said Mr. Grim.

Article 4

Councils flaunting Clean Waters Act

A SURVEY of almost 60 Hypothetical Bay sewage treatment plants has found that less than one in 10 fully complied with the standards of the Clean Waters Act.

Environment Minister Mary Robertson, who announced the survey results in Hall Rocks yesterday, said her department was already preparing to prosecute some operators while others had been ordered to upgrade their plants.

The release of the survey results follows allegations by the Surfrider Foundation that only one in five Hypothetical Bay councils complied with government discharge licences.

Collins Creek, Hall Rocks and Watson Bay councils have all been short-listed by the foundation for assessment of possible breaches of effluent discharge standards,

Ms. Robertson, who opened a seminar on Hall Rocks's sewage strategy, said she had ordered a review of the performance of the State's sewage treatment plants in January after being concerned for some time on the issue.

Nearly 200 letters were posted out to operators, including councils, industries and resorts, requesting the results of their own monitoring programs within 14 days.

About 18 did not even respond, while nearly 10 percent said they did not have monitoring programs as required by their licences.

Ms. Robertson said overall compliance with all the quality and quantity parameters, which are supposed to be monitored, was "relatively rare and is probably achieved by less than 10 percent of licences".

The department has since ordered licence holders to detail their plans to upgrade their practices and procedures to comply with their conditions.

"Let me be clear about this - the aim of this review is to ensure that every sewage treatment plant in Hypothetical Bay complies with the discharge standards stated in their licences. It is not about closing down sewage treatment plants - that serves no benefit," said Ms. Robertson.

But she said that those operators who refused to comply with standards would be prosecuted.

All three coast councils have been hit by allegations concerning their sewerage systems in the past year.

Yesterday's seminar at Sunshine Beach was convened by People Opposing Outfalls, the Surfrider Foundation and the Sunshine Coast Environment Council and sponsored by Hall Rocks Shire Council.

Surfrider Foundation Hypothetical Bay executive director Brad Smith said both Collins Creek and Hall Rocks, as ecotourism areas, had to give a clear message to coastal councils around Australia that dumping sewage out to sea was no longer acceptable.

"If it can happen here, it is open slather around the coastline," Mr. Smith said yesterday at a seminar in Hall Rocks on sewage strategies.

And Mr. Smith has warned that Watson Bay City Council would one day live to regret installing its ocean outfall at Kontos Creek.

"The threat won't be realised by the local people here until there is a sheer crush of population growth in the area," Mr. Smith said.

He said that the outfall would in years to come pose a significant health threat to people bathing near the area, especially as discharge volumes increased.

Mr. Smith said the region's huge tourism industry relied on clean beaches and clean water to swim in.

Article 5

Fear toxins could enter Lynch River

FURTHER development of the flood plain at Warne Cove could lead to deadly toxins finding their way into Lynch River, it was claimed this week.

The Australian Conservation Foundation has accused Harbour Town Shire Council of failing to act on a toxic creek at Warne Cove, although the council has known about the problem for more than a month.

Attacking the council for its lack of action, the secretary of the foundation, Matt Keysmith, said the council had been aware of the creek's condition for several weeks yet had done nothing.

"Two creeks flowing from the Warne Cove flood plain contain extremely high levels of acid sulphate, a substance that is toxic to all marine life," said Mr. Keysmith.

"Potential acid sulphate soils are scattered throughout the Warne Cove and Merrimac flood plains.

"Leachate from these soils has been entering the canal systems through the creeks and poisoning Lynch River.

"Council officers have been aware of this problem for more than a month and yet nothing has been done to alleviate the situation."

Mr. Keysmith and Harbour Town Shire mayoral candidate Jeanie Keen has drawn the attention of the foundation to the condition of the Warne Cove flood plain.

Mrs Keen was concerned about the toxicity of the area and had called for an environmental impact study of Jensen River.

Mr. Keysmith said acid sulphate soils contained aluminium, which was highly toxic to marine creatures.

"The mangrove creeks' drainage into canals from the Warne Cove flood plain contained fish and crab nurseries," he said.

"Oxidisation of acid sulphate soils has poisoned all species that had been breeding in this creek.

"The toxic flow has been allowed to continue poisoning Jensen River and Lynch River for the past four weeks."

Mr. Keysmith said the blame for this situation rested with Harbour Town Shire Council, as it had been aware of the high level of acid sulphate in the flood plain for a number of years.

"Council is pushing to develop the Warne Cove flood plain at great peril to the health of Lynch River," he said.

"Disturbing the floodplain will lead to further toxic leachate entering the creeks and then Lynch River.

"The council needs to wake up and realise that further development on these flood plains will lead to more acid sulphate leaching into our waterways.

"The Harbour Town Shire draft town plan fails to address the issues related to potential acid sulphate soils so they could well be sitting on a toxic time bomb" said Mr. Keysmith.

Article 6

LOCALS SET FOR MAJOR FIGHT AT COLLINS CREEK

Wet Paper

Collins Creek residents at last week's protest rally against creek pollution

Mariner City community groups are gearing up for one of the biggest environmental fights on the tourism strip - the clean-up of Collins Creek at Batestown.

Collins Creek residents, greenies and Aborigines have vowed to take their case to clean-up the polluted waterways to the highest level.

Green activists and Aboriginal groups plan to use the rehabilitation of the creek to spearhead their environmental policy on the Mariner City.

At the second meeting of the Mariner City Aboriginal and Islander Co-operative on Saturday, the group resolved to use the creek rehabilitation as a pilot project in developing guidelines for community involvement in environmental management on the Mariner City.

Chairman of the meeting Mr. David Dawson said Collins Creek would be a good start to determine whether an environment advisory committee to the councils would work.

"It will be a good way to show our credentials and earn some respect," said Mr. Dawson.

"I do believe we have to get a working relationship with the council.

"With all of the parties working together in one direction, so much can be achieved."

He said the problem of sewerage overflow and back-up of water at Collins Creek had affected a large number of homes in the area.

Outraged Collins Creek residents are prepared to take their case to Environment Minister Mary Robertson in a bid to have the waterway cleaned up.

The city council will be asked to put up signs, saying Collins Creek is a health hazard to swimmers.

This follows a protest meeting of about 200 Collins Creek residents held last week.

Local alderman Peter Lawless said the problem was a difficult one and dredging was not the answer.

Ald Lawless met the Wildlife Preservation Society last week in a bid to re-introduce wildlife to the creek.

Collins Creek has become a natural habitat for many species of waterbirds. Its tidal reaches are also a breeding ground for crabs and other marine life.

City Council health department experts took readings at Collins Creek on January 27.

The faecal coliform count on the corner of Barrattum St and Terrigal Crescent was 800 per 100 mL. Other readings along the creek were between 190 and 560.

One of the convenors of the public meeting, Jan Luscombe, said the condition of Collins Creek had a direct bearing on the quality of Lynch River.

She said swimmers were now risking their health by paddling in the creek.

"Collins Creek has become one of the dirtiest and most polluted stretches of water in Australia," she said.

"I blame the council for not doing something about it."

Ald Lawless said he had never seen any evidence of industrial pollution at Collins Creek.

Ald Criton said Ald Lawless "should be ashamed of himself and go and have a look at the problem".

Article 7

LYNCH RIVER HIT BY FATAL FLUSH

ENVIRONMENTALISTS fear Lynch River will become a giant lavatory bowl unless the Gross Government introduces hefty fines for polluters.

Lynch River pollution problem has also prompted the Mariner City Council to call on the Hypothetical Bay Government to introduce standard regulations for sewage disposal from boats.

Surfrider Foundation national president Brad Smith intends to discuss the problem with Environment Minister Mr. Pat Combener during talks in Brisbane today.

Mr. Smith said lobbying by his group about pollution problems in Sydney Harbour has resulted in new legislation to be introduced in July this year where polluters will face fines of up to $1500.

Mr. Smith yesterday accused the Hypothetical Bay Government of ignoring environmental problems on the Mariner City.

He said the government had given priority to buying and protecting large tracts of grazing land in western Hypothetical Bay.

"The Mariner City is very much undervalued by the State Government. We want them to establish a coastal pollution monitoring body," said Mr. Smith.

He said environmentalists were not satisfied with the monitoring of pollution in Lynch River.

Council inspectors have confirmed that water quality tests have sometimes revealed high levels of faecal coliforms near marinas on Lynch River.

The council staff believe the most likely reason for the high recordings was the discharge from lavatories on boats.

"Lynch River is being used as a giant toilet bowl. With the run-off of metals and pesticides, you have potentially a very lethal chemical cocktail there," said Mr. Smith.

"In the next 10 years we could very well see the demise of Lynch River as a recreational area."

Mariner City Council Planning and Development Committee chairman Alderman Peter Lawless said yesterday council staff had produced a policy document on the control of waste-disposal facilities at marinas.

Ald Lawless said the council would prefer the Hypothetical Bay Government to introduce a uniform policy rather than forcing the council to act independently.

"The future of Lynch River is at stake by developments and the dumping of sewage by boats," said Ald Lawless.

"The solution appears to be easy: boats should be required to have sewage holding tanks and sewage pump-out facilities should be built on all marinas."

Ald Lawless said the Transport Department should ensure that all new vessels in Hypothetical Bay contained suitable holding tanks and existing craft should be required to have similar equipment by the year 2000.

A Transport Department spokesman said the department was reviewing marine legislation regarding holding tanks and sewage facilities.

The spokesman said laws were introduced in September, 1991, which required new commercial vessels that were equipped with flush toilets to have holding tanks.

He said if future legislation was retrospective it could cause financial problems for boat owners.

Article 8

GREEN SEEKING END TO OUTFALLS

AUSTRALIAN Democrats leader Cheryl Green has called for the phasing out of sewage ocean outfalls by the year 2005.

Speaking at the Mariner City Marine Symposium yesterday, Senator Green backed a push by environmental groups for a moratorium on ocean outfalls.

"We have to turn it around now," she said.

Senator Green also criticised last week's Federal Government Budget which 'contained little for the environment in general and particularly for coastal management'.

Senator Green said she would lobby new federal Environment Minister John Forktongue in a bid to have ocean outfalls phased out.

She said there was 'total conflict' in the Hypothetical Bay Government's newly-declared Mortonian Bay Marine Park being used by local councils for ocean outfall.

Mariner City mayor Gary Bailey yesterday said the city council's policy was to reuse as much of its effluent as possible on parks and gardens.

"We are up to 60 percent now," councillor Bailey said.

"The practicality of it is if you don't have ocean outfalls, what do you do with it?"

When it rained, no one wanted treated effluent for watering and, while the reuse of effluent for domestic purposes was on the councils 'long-term' agenda, it would require public acceptance.

But Senator Green said there were alternatives being developed by private enterprise which could be considered.

Senator Green met Surfrider Foundation national executive director Brad Smith yesterday to discuss the issue.

Mr. Smith last week called for the Newtown Government to stop its eight proposed ocean outfalls.

Mr. Smith said the moratorium bid was gaining support among politicians and lobby groups.

Senator Green said she hoped Mr. Forktongue would consider a set of national standards foe effluent and stormwater management, which would include a moratorium on ocean outfalls.

Senator Green also wants a higher priority for coastal management.

"I plan to do everything in my power to persuade Mr. Forktongue," she said.

Article 9

INSECTICIDE FIND SPARKS COMMUNITY OUTRAGE

Recent fish kill in Lynch River last Tuesday (Tim Ryan Photo)

A new insecticide, hypotoxinade, has been blamed for last Tuesday's fish kill in Lynch River according to Mariner City health inspector Ms. Wendy Watson.

"The insecticide came from an empty drum which was washed out into a stormwater drain and investigations will most likely lead to prosecution," Ms. Watson said.

Mayor of Mariner City Mrs. Sun Lu said that if any of the resorts were using it to kill mosquitos then they faced heavy fines and loss of licence to operate ecotourism ventures.

"In 1998 we had similar problems and it was agreed that all facilities had to have on site treatment of all chemicals. Boats had to be washed down in places where all runoff could be trapped and treated on site and then discharged into the sewerage system," Mrs Lu said.

"People who continue to break this law would be heavily penalised."

Local Surfrider Foundation president Mr. Matt Keystone said it was an outrage that given the education programs in the community anyone should be so stupid as to tip anything down a stormwater drain.

"We already have problems with over crowding of our surfing beaches and the continual threat of a major airport disaster. "

"The fifth runway planned will pass directly over the Slaughter National park and be an environmental disaster," he said.

According to local councillor and developer Mr. Max Milliamson, the fifth runway was necessary to keep up with the demand from Asian countries whose beaches had become so polluted they could go nowhere else for a holiday.

"Mr. Keystone is just trying to slow progress and with the recent downturn in the economy development is essential," he said.

Exercise 141 Best

environmental practices

Acknowledgement is made of the Great Barrier Reef Marine Park Authority for allowing reproduction of the draft statements of best environmental practice to be published here.

Group discussion

Read the articles for discussion in Figures 141.1 to 141.4 and discuss the following statements in your group.

Use the butcher's paper and pen provided to write all the reasons your group can think of as to why each rule was introduced.

Use the blue tack to pin these to the wall when finished and make a short presentation to the class.

1. If a vessel does not have a holding tank, visitors should use toilets before and after they reach the reef.
2. Where installed, use approved public moorings in preference to anchoring.
3. Fish should not be fed directly by hand, but fed by broadcasting food into the water.
4. Remove any seeds or introduced plants from your clothing or shoes before landing on an island.
5. Do not disturb seabirds or turtles. Avoid making loud noises, using strong lights or making sudden movements near to where turtles or seabirds are nesting.
6. Keep dogs away from turtles. Note: dogs are not permitted in National Parks or on most adjoining beach areas.
7. While on the island don't feed seabirds food scraps as they must learn to find their own food.
8. When diving do not chase or attempt to ride or grab free swimming animals. Avoid blocking their path.
9. When snorkelling do not rest or stand on coral. If you must stand up make sure it's on sand.
10. Make a common walking track to the beach when camping on an island.

Alternate discussion

Read all the articles and rate those in order from most important to least important.

Materials and equipment (per group)

- best environmental practice fact sheet
- butcher's paper
- blue tack
- marking pen

Note: At time of publication the Great Barrier Reef Marine Park Authority was drafting a paper on best environmental practice.

For an update on this publication you can contact:

Great Barrier Reef Marine Park Authority PO Box 1379
Townsville 4810
Telephone (079) 818811

While on the water

Waste disposal

Increasing nutrients in reef waters and marine pollution pose major threats to offshore islands and reefs. Many Governments have recently introduced legislation requiring all new vessels over a set length to fit toilets and holding tanks from January 1998. Existing vessels over 10 metres must be fitted with toilets and holding tanks by January 2000, unless they cannot be modified to hold a toilet and holding tank and obtain an exemption. Many governments are currently developing regulations concerning the discharge of wastes. Some Commonwealth authorities are considering the introduction of complementary legislation for sewage discharge.

The following legal requirements apply to the disposal of wastes in some Marine Parks:

- The discharge of garbage (including plastics) and oil products within a Marine Park is totally prohibited, with the exception of human wastes when discharged from a vessel and fresh fish parts from fish caught in the Marine Park.
- If a vessel contains a holding tank, sewage must be discharged more than 500 metres from the edge of the nearest reef.

Best environmental practices for waste disposal in a Marine Park could be:

- If a vessel contains a holding tank, use pump ashore facilities for sewage disposal wherever possible. Where these facilities are not available, discharge sewage in open water (e.g. shipping channel).
- If a vessel does not have a holding tank, visitors should use toilets before and after they reach the reef.
- Use biodegradable toilet paper and cleaning products.
- Petroleum products in the bilge should be broken down with biodegradable degreasers and pumped into onboard storage containers and disposed of at recycling depots onshore.
- Encourage visitors not to urinate in the water at the reef.

Anchoring

Anchors and chains wreck fragile coral environments. Remember coral is a living organism. Each anchor makes a difference. Anchor with care.

In a Marine Park you are required to comply with anchoring areas.

Best Environmental Practices for anchoring in a Marine Park could be:

- Where installed, use approved public moorings in preference to anchoring.
- Carry the right gear - enough chain or line to anchor on 30 metres of water.
- Check out the area before anchoring.
- Anchor in sand or mud away from live corals and be sure your chain is clear of coral.
- Motor towards the anchor when hauling the anchor in.

Fish feeding

Fish Feeding is one of the most popular activities carried out from tourism vessels and is often the highlight of many visitor's trip to a Marine Park.

Commercial tour operators require special permission from the some Commonwealth authorities and environment departments to carry out fish feeding and are provided with guidelines outlining how to conduct activities. Fish feeding may result in undesirably aggressive behaviour in some fish and can be dangerous to the person feeding the fish or others close by in the water.

Most food fit for humans is not suitable for fish and may damage their health. Please help to ensure the effects of fish feeding are minimised by following the best environmental practices outlined below:

- If you are feeding fish as part of a tourism operation, fish feeding should only be conducted by staff.
- Fish should not be fed directly by hand, but fed by broadcasting food into the water.
- People should not be in the water at the time of fish feeding.
- Feed fish only raw marine products or fish pellets.
- Feed fish no more than 1 kilogram of food per day per site on the reef.

Fishing

The most popular recreational past time on reefs is fishing. Fishery stocks need everyone's help to remain at a sustainable level.

In many Marine Parks it is a legal requirement to abide by Zoning Provisions (no fishing in green zones and some restrictions in yellow zones), bag limits, size limits and seasonal closures.

Best environmental practices for fishing could be:

- Take only what you need.
- One fish one hook.
- Resist fishing spawning aggregations.
- Report any tagged fish caught to the Department of Primary Industries, (toll free number 008-077001).

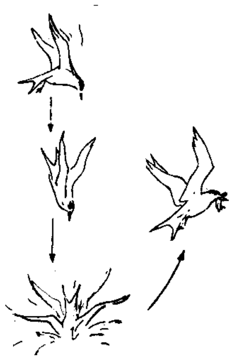


Figure 141.1 An article for discussion — best environmental practice while on the water

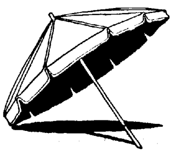
While ashore

Visiting Islands

Islands within Marine Parks are a popular destination for tourists and locals alike.

Best environmental practices for visiting islands in a Marine Park could be:

- Check with your local Department of Environment office before visiting islands for any special requirements, and obtain appropriate permits before camping. Camp only in designated camp sites.
- Check on Marine Park Zoning requirements before fishing and collecting around islands.
- Take any litter or rubbish back to the mainland for disposal.
- Do not use detergents, toothpaste or soap in creeks or streams. Wash at least 50 metres away from water courses.
- When cleaning dishes use sand and a scourer to remove waste.
- Use gas or liquid spirit stoves for cooking. Open campfires are not encouraged, and are not permitted in some locations.
- Always use toilets where provided.
- Where toilets are not provided, select a spot at least 100 metres away from campsites and water courses. Dig a hole at least 15 centimetres deep and bury all faecal material.
- Remove any seeds or introduced plants from your clothing or shoes before landing on an island.
- Do not disturb vegetation or break branches from trees or shrubs.
- Do not disturb seabirds or turtles. Avoid making loud noises, using strong lights or making sudden movements near to where turtles or seabirds are nesting.
- Do not take animals or plants on to islands nor feed the native animals.



- Do not write or place graffiti anywhere.
- Keep to common walking tracks or designate a common track to follow.
- Do not use generators or compressors unless you have special permission.
- Do not play amplified music on island National Parks.

Reef walking

Reef walking is a popular activity for exploring the intertidal area or reef flat. Reef walking has the potential to be particularly destructive to the marine environment. Please help to ensure human impacts are minimised.

Best Environmental Practices for reef walking could be:

- Watch where you walk so as not to step on any coral or living matter.
- If there is a marked trail, follow the markers and avoid straying or taking short-cuts.
- If there is no marked trail take time to find any regularly used trails or, follow sand channels.
- Use a pole or stick for balance and not to poke or prod animals.
- Return any boulders you overturn to their original position.
- If you pick anything up, living or dead, always return it to the exact position in which you found it.
- Do not pick up or remove species which are attached to the reef flat.
- Be aware of Marine Park collecting restrictions.

Additional practices for guided reef walks:

- Keep group size to a maximum of 15 people wherever possible.
- Keep walkers in a group on the reef flat, and where possible break the main group into smaller groups.
- When following a marked trail, maintain single file formation between points of interest.

Turtle watching

Some reef islands are a critical breeding ground for sea turtles or penguins which come ashore at night to lay eggs and are easily disturbed by light, noise and movement. Whilst it is possible to watch the females laying eggs, and hatchlings emerge from the sand, please ensure your presence does not adversely affect this wonderful breeding process.

Best environmental practices for turtle watching could be:

- Keep the use of lights to a minimum while you are walking along the beach.
- Do not approach closely or shine lights on the turtle as she leaves the water or moves up the beach.
- Wait until the turtle is laying her eggs before shining lights on her.
- Avoid excess noise and sudden movements.
- Keep dogs away from turtles. Note: dogs are not permitted in National Parks or on most adjoining beach areas.
- Learn about the habits and needs of turtles.

Observing seabirds

Many reefs are the home to thousands of seabirds which have flown a very long way to rest before continuing on. Many of the islands play a critical role for seabirds as breeding and nesting sites. Be aware of protected areas and seasonal closures in Zoning Provisions, and help to minimise sea bird disturbance. Some key island nesting areas are totally closed to entry.

Best Environmental Practices for observing seabirds could be:

- Be quiet and avoid rapid or sudden movement.
- Avoid walking near or over areas where ground nesting birds are present.
- Approach seabirds crouching down and where possible make use of existing cover to observe birds.
- Don't approach seabirds to the point where they become nervous and above all don't chase birds away.
- Don't walk into roosting or nesting colonies, or cause birds to move from nests or young.
- Minimise and where possible avoid using lights near or in the bird colonies.
- Take particular care on seabird islands at the following sensitive times:
  - late afternoon, early evening, during the hottest part of the day, in wet / or cold weather, moonlit nights, when eggs, naked or downy chicks are in their nests.
- Learn about their habits and needs and don't feed them food scraps as they must learn to find their own food.

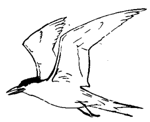
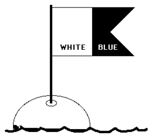


Figure 141.2 An article for discussion — best environmental practice while ashore on am offshore island or reef

WHILE IN THE WATER



Diving

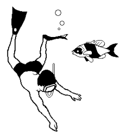
Scuba diving is one of the most popular activities in a Marine Park. All divers should be aware that it is an offence in the Marine Park to damage or remove coral. Ensure that your diving has minimal impact.
Best Environmental Practices for diving in a Marine Park could be:

- Practice buoyancy control and ensure you are weighted correctly.
- Do not rest or stand on coral. If you must stand up make sure it's on sand.
- Avoid touching anything with your fins and be aware of disturbing sediment or coral.
- Secure dragging equipment such as gauges.
- Observe animals rather than handle them directly. Handling some animals may be dangerous.
- Do not chase or attempt to ride or grab free swimming animals. Avoid blocking their path.
- Do not poke or prod any plants or animals.
- If you pick up anything under water, living or dead, always return it to exactly the same position.
- Do not lean on coral to support yourself while taking underwater photographs.

Snorkelling

Snorkelling is one of the best ways to explore a Marine Park.
Best Environmental Practices for snorkelling in a Marine Park could be:

- Practice snorkelling techniques away from living coral.
- Control your fin kicks, especially in shallow water.
- Avoid touching anything with your fins, and be aware of disturbing coral and sediment.
- Do not rest or stand on coral. If you must stand up make sure it's on sand.
- Observe animals rather than handle them directly. Handling some animals may be dangerous.
- Do not chase or attempt to ride or grab free swimming animals. Avoid blocking their path.
- Do not poke or prod any plants or animals.
- If you pick up anything under water, living or dead, always return it to exactly the same position.



BEST ENVIRONMENTAL PRACTICES IN GENERAL

- Respect any areas of cultural or historical significance.
- Respect other people using a Marine Park.
- Be aware of the effect of your activity on other people and avoid conflicting activities in the same area.
- Take the time to learn about a Marine Park and how to minimise the impact of your activity on a reef environment.

Reporting procedures

You can help managing agencies to manage a marine park and islands more effectively by assisting in the reporting of any of the following activities or incidents:

- Any suspected breach in law (including illegal fishing and collecting) to your nearest Marine Parks office.
- Oil spills or any form of marine pollution.
- Marine mammal sightings.
- Crown of thorns starfish, suspected ballast water invaders (see exercise 99 or *Drupella* sp if you live in WA).
- Natural history observations including fish spawning, coral bleaching and algal blooms.

Research activities

Understanding how the natural ecosystem works and the effect of human interactions with the environment is fundamental to the successful management of a Marine Park.
Research activities have the potential to significantly impact on the marine environment.
In some states it is a legal requirement to obtain the necessary permission from the Management Authority to conduct a research program.
Best Environmental Practices for research activities in a Marine Park could be:

- Ensure your research program is having minimal impact on the physical reef environment and the visual aesthetics of frequently visited sites.
- Ensure your activities are not interfering with those of other reef users.
- Explain the purpose of the research program to interested reef users and where appropriate provide the opportunity for community involvement.
- Provide updates on the progress of the study and feedback research results to those who have provided assistance in setting up and conducting the research program.
- Remove any hardware from the study site following the completion of the research program.

Figure 141.3 An article for discussion — general best environmental practices including while in the water

Exercise 142 Problem solving

Based on an original exercise by Gwen Connolly.

Method

1. In order to extract, enhance and organise information, we need a strategy which connects analysing and synthesising with the grammatical functions.

   A framework such as 5W+H will allow the access we need to any piece of writing. It will also stimulate further questioning and a flow-on of ideas.

2. Select a relevant article to your area or use the one provided in Figure 142.1.

   Then divide your class into 6 groups and call the groups Who, What, When, Where, Why and How. Label each group's piece of butcher's paper in the same manner.

3. Now read the stimulus letter in Figure 142.1 or the one you have selected. In reading the article, you must be able to extract the facts and then organise them so as to truly evaluate the article's worth. This activity will show you how this can be done.

4. Select a piece of butchers paper for your group.

   It will be labelled either: Who?, What?, When?, Where? or How?

5. As a group, your task is to select and write down 3 questions arising from the article.

   The following is an example:

   Who wrote the article? (an example of accuracy in comprehension).

   Who is the author addressing the article? (an example of interpreting comprehension).

   Who do you believe is right? (an example of applying the comprehension - you will need to defend your opinion at this level).

6. When your three questions are complete, blue tack your paper to the wall for other groups to view.

7. Move around the room now and answer all the questions.

ANGLERS NEED TO ALTER THEIR WAYS

As an amateur fisherman with a long standing commitment to nature conservation, I am concerned at the extreme action by fishing clubs and others to the action taken by Environment Minister Mary Robinson to provide a resolution period in which the future of fishing in certain national parks can be determined.

It seems that the strength of this reaction will now ensure that reasonable consultation and careful consideration of the issue will not happen.

I recognise the strength of the reaction is indicative that many communities have strong cultural ties with amateur fishing and with localities in which fishing occurs.

Surely though it is time for us to accept, as we have with the Great Barrier Reef Marine Park, that there should be areas zoned for a range of activities and that some zoned areas of total protection should be included.

If the views expressed so strongly are typical, then I wish to distance myself from my fellow anglers on this issue. I believe that it is time to highlight the impact which amateur fishing has on the environment, mostly because a vast majority of us do not care or cannot recognise the degradation we are causing.

It is obvious that popular fishing destinations are usually the most disgustingly littered sites, with everything from food and bait packaging to broken crabpots.

The telltale signs of direction taken by wildfire anywhere along the Queensland coastline show that a disproportionate number of fires have originated from beach or mangrove areas. Invariably these are fisherman's cooking fires or smoke fires lit to reduce the biting insects.

The growing number of silver gulls in well used areas are a threat to the future of nesting birds of other species such as terns.

How many fisherman recognise that their careless handling of bait and fish carcasses has been the primary cause of the gull explosion?

Overpowered boats roaring up shallow estuarine breeding grounds and throngs of four wheel drive vehicles which crunch over the eggs of beach nesting terns, oyster catchers and plovers are other features of this fishing scene.

The amateur fisherman is just as much to blame as the professional for the accidental impact by boats on turtles and dugong and the disruption of feeding and breeding grounds of these species.

Unless anglers learn to minimise their impacts and be less greedy in their capture of freshwater and marine life, the need for increasing legislative constraints will escalate.

Figure 142.1 Stimulus article

MATERIALS AND EQUIPMENT (PER GROUP)

- 1 sheet of butcher's paper
- blue tack
- marking pen

Exercise 143
Images essay

Based on an original exercise by Tim Ryan, Maryborough State High School.

Essay

What images does this cartoon give you when considering the immediate and future demands upon renewable and non-renewable resources in terms of immediate and future requirements?

Write a 200 word essay on the cartoon shown in Figure 143.1 using the following as a guide.

1. Describe the conversation between the fish and the dolphin that are washed up on the beach.
2. What do you believe could be the message in the bottle.
3. Suggest a reason why the planet is dying.
4. Describe how you would feel if you were the man sitting on the beach.
5. Which do you think has the most right to life on the earth, the dolphin or the fish?

   In deciding, look at what each contributes and give reasons for your decisions.
6. You have just bought this island.
   - How would you manage the resources of the island?
   - What legislation might you develop to protect your island?

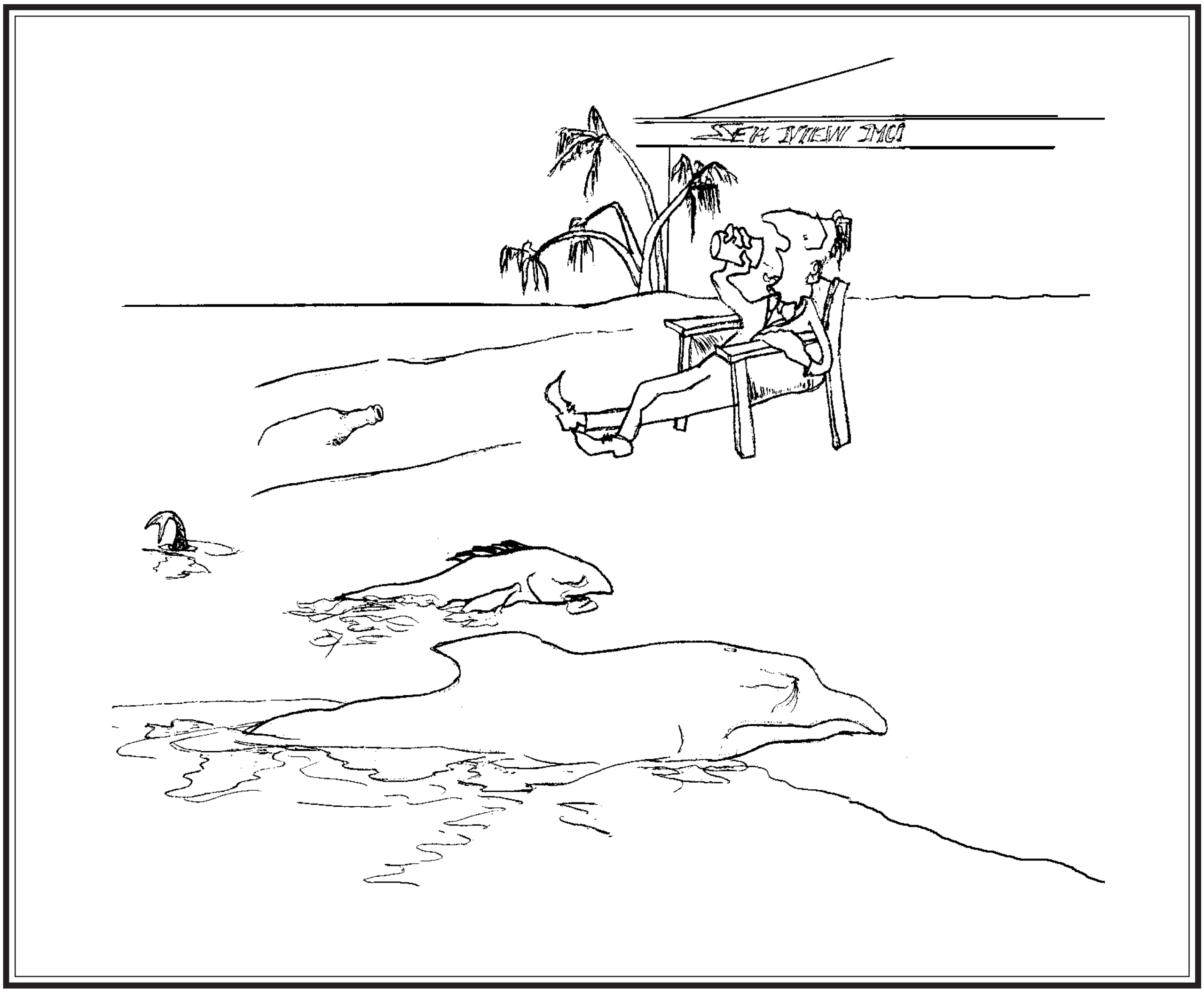


Figure 143.1 I wonder what the water is like?

EXERCISE 144 WHALE BAY GAME

METHOD

1. Complete Exercise 117 before this activity so that you know the colours of the zones.
2. Use colouring pencils and, following the colour key in Figure 144.1 colour in the zones as proposed by the management committee.

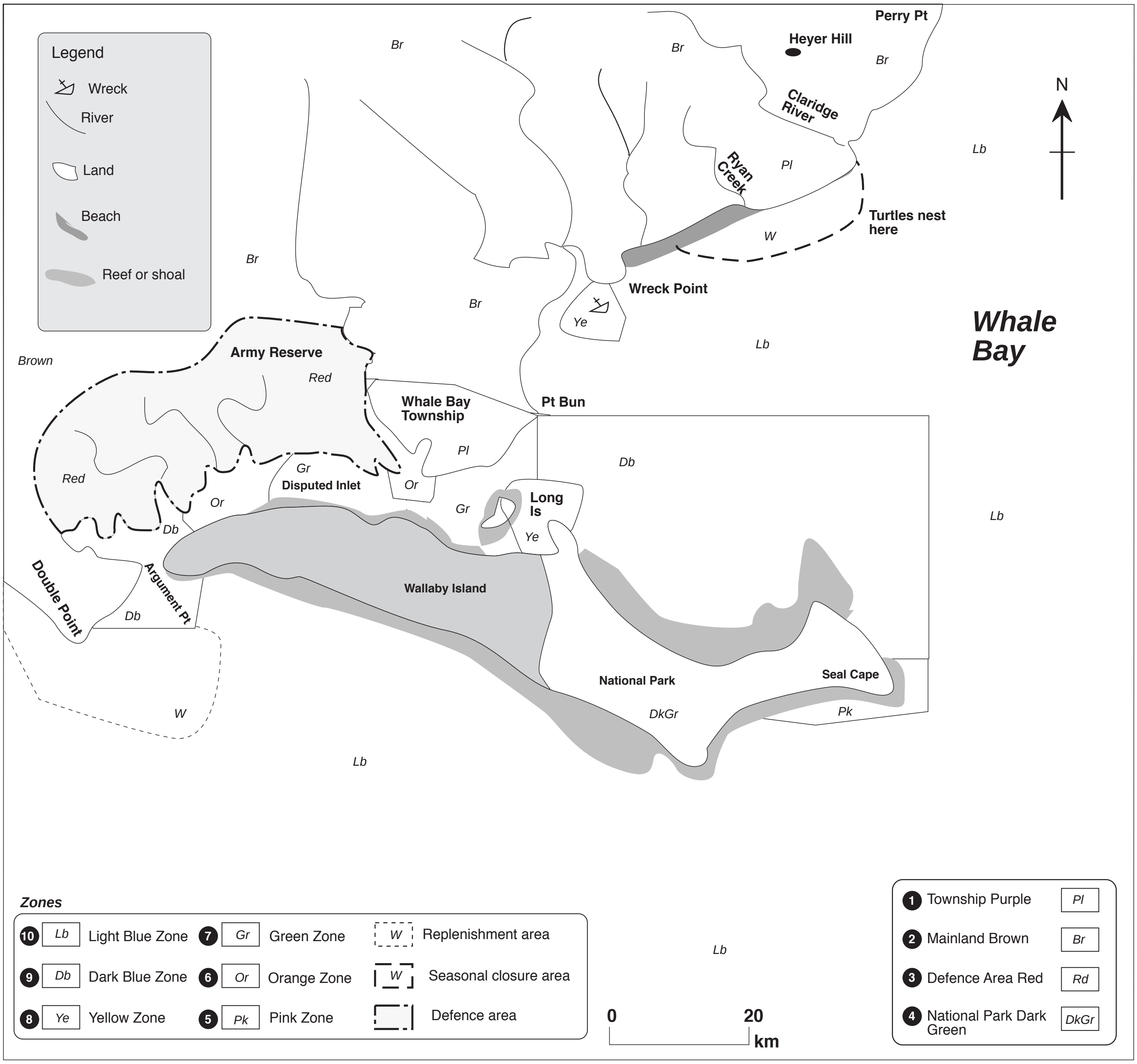
QUESTIONS

Turn to your textbook (Page 598), read the information section on Whale Bay and answer the following questions.

1. Mark in where mangroves and sea grass beds are located?
2. Circle the following coastal features:
   - Seal Point
   - Perry Point
   - Heyer Hill
   - Pt. Bun
   - Seal Cape
   - National Park on Wallaby Island
   - Double Point
   - Long Island
   - Ryan Creek
   - Claridge River
   - Wallaby Island.
3. Mark in where turtles nest.
4. What type of industries use the bay?
5. Where do the whales breed and when do they come to the bay?
6. What regulations are already in place, use colours to mark in the existing zoning plans.
7. How effective are these plans as they now stand?

THE GAME

1. Elect a class chairperson, reporter, photographer and secretary to form the management authority that will oversee the game. (You can read about the types of people these are in your textbook Chapter 20)
2. Now divide the rest of the class up into the following interest groups. (You may choose to follow the book's description, but this is more complicated and takes longer)
   - conservationists
   - developers
   - recreational fishers
   - divers or surfers
   - commercial fishers
   - charter boat operators
   - residents action group
4. Each group is to:
   - Develop a list of group principles and objectives.
   - Write a press release and give it to the reporter you elected earlier.
   - Propose a zoning plan for the bay and using the colours from Figure 114.1, draw a coloured zoning scheme as proposed from your group.
   - You should make an overhead transparency from Figure 144.2 and use overhead pens to explain at the public meeting.
5. The job of the committee to manage the bay is to advertise the meeting and publish a Whale Bay News item to be read out to the class.
6. When all groups have finished their plans, the class meets in a mock meeting to discuss the zoning plans of each group.
7. The elected committee attempts to reach a compromise and come up with a common zoning plan.



Permitted activities guide	Bait netting and gathering	Camping	Collecting (recreational not coral)	Collecting (commercial)	Commercial netting (see also bait netting)	Crabbing and oyster gathering	Diving, boating and photography	Line fishing (bottom fishing, trolling etc)	Research (non-manipulative)	Research (manipulative)	Spearfishing	Tourism and education (facilities and programs)	Traditional hunting (fishing and gathering)	Trawling
10 General Use A Zone Lb	Yes	Permit	Limited	Permit	Yes	Yes	Yes	Yes	Yes	Permit	Yes	Permit	Permit	Yes
9 General Use B Zone Db	Yes	Permit	Yes	Permit	Yes	Yes	Yes	Yes	Yes	Permit	Yes	Permit	Permit	No
8 Marine Park A Zone Ye	Yes	Permit	No	No	No	Limited	Yes	Limited	Yes	Permit	No	Permit	Permit	No
7 Marine Park B Zone Gr	No	Permit	No	No	No	No	Yes	No	Yes	Permit	No	Permit	No	No
6 Fish Habitat Zone Or	No	No	No	No	No	No	No	No	Permit	Permit	No	No	No	No
5 Preservation Zone Pk	No	No	No	No	No	No	No	No	Permit	Permit	No	No	No	No
Replenishment Zone W	No	No	No	No	No	No	No	No	Permit	Permit	No	No	No	No

Figure 144.1 Students may make one copy of this page so that they can attach their answers before handing in for marking.

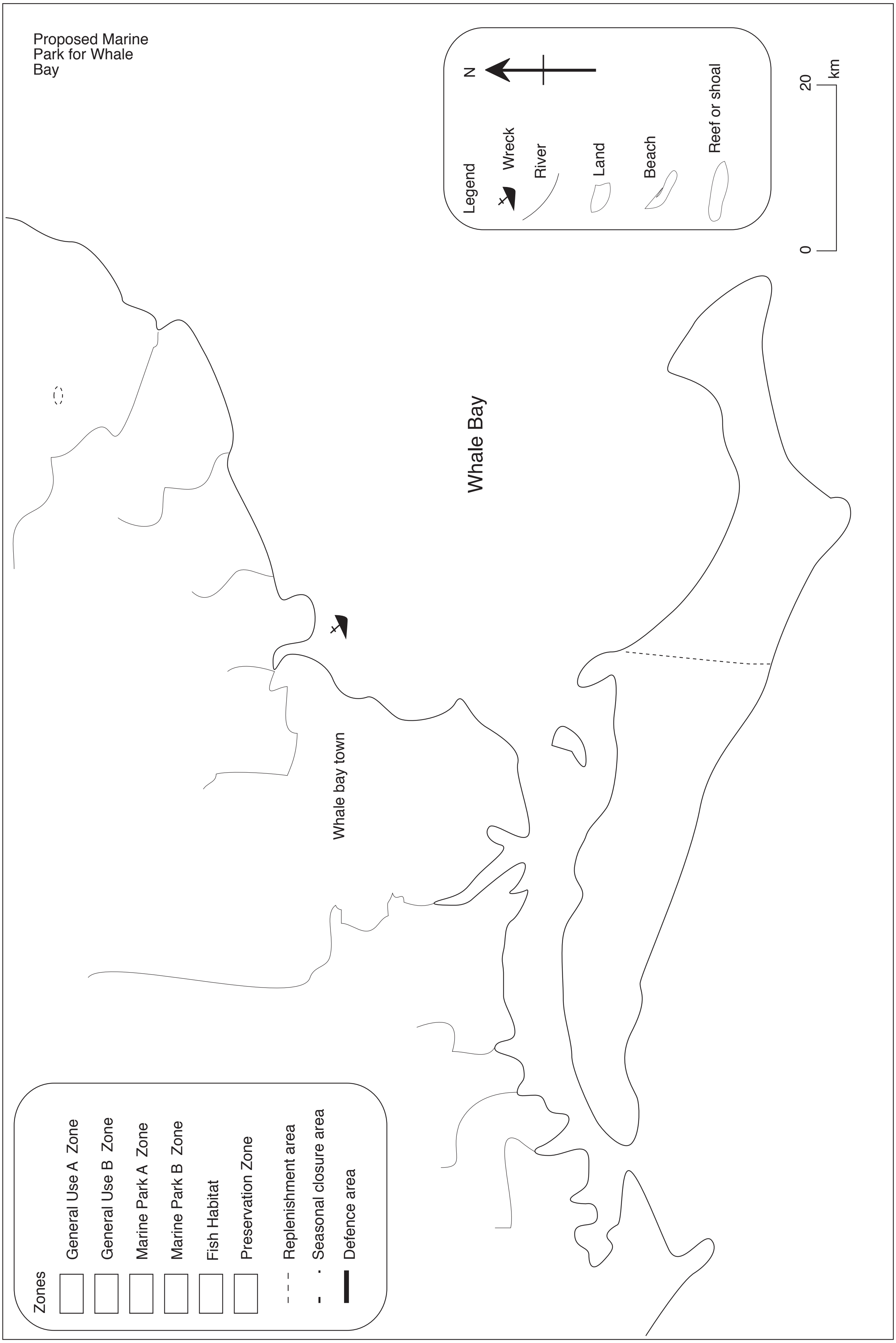


Figure 144.2 Whale Bay blank map. Students may make one copy of this page so that they can attach their answers before handing in for marking.

Exercise 145
Traditional management methods

Thanks to David and Graham Dillon from the Gombemberri Tribe, Gold Coast, for assistance in designing this activity.

Questions

Aboriginal and Torres Strait Islander communities often had a calendar by which they hunted animals.

1. Make contact with your local Aboriginal elders and go and see them about your school's interest in Aboriginal management methods.
2. Ask assistance in completing Figure 146.3 and find out what type of management the local tribe used to practice.
3. Find out what you can and cannot write down and see if one of the tribe would like to tell some stories to your class. See if you can find out when the fish could be hunted and find out if there are any special ceremonies that the tribe would like to share with your school.
4. Ask if you could share in a class painting with traditional Aboriginal sea life like the one shown in Figure 146.1. Find out if there are any local stories that can be told to explain how there was no division between land and sea.

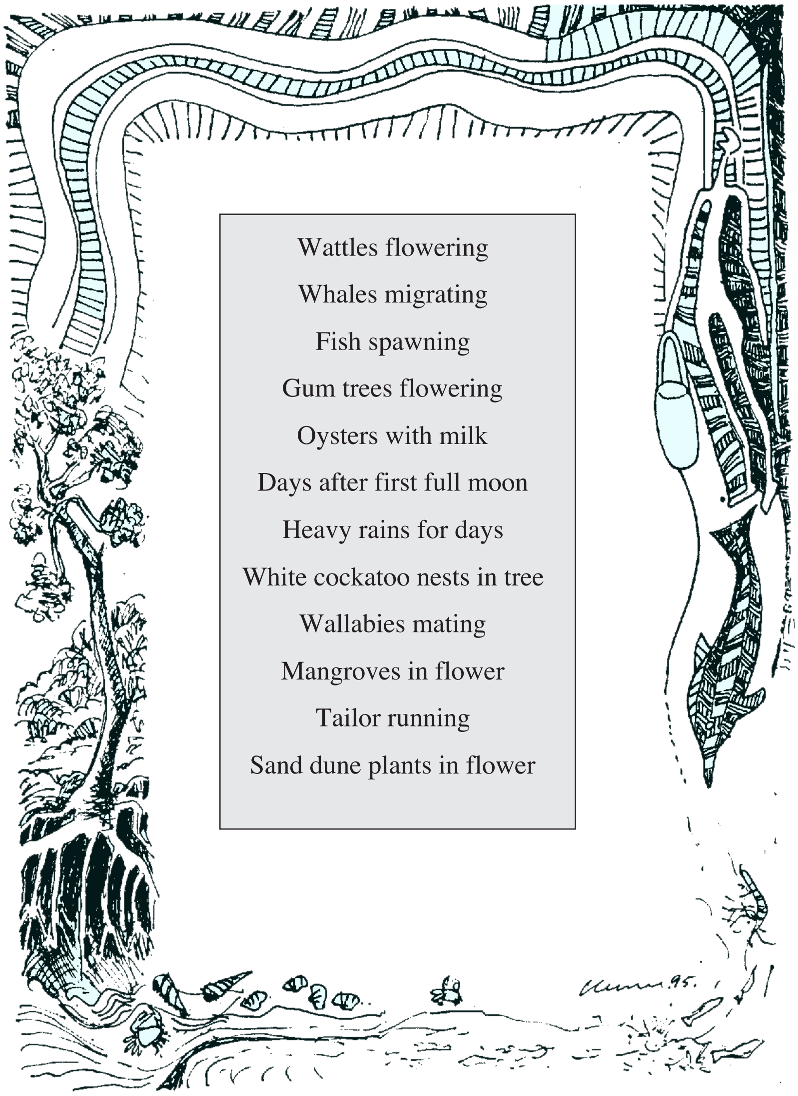


Figure 146.1 Ideas for a natural events calendar. Border illustration by Ron Hurley, Gurang Gurang Tribe, Gladstone

Natural event in calelander	Permitted Aboriginal or Torres Strait Islander activity

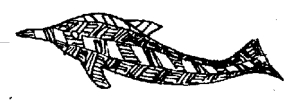


Figure 146.3 Calendar of natural events and management strategies

Exercise 146 Drain

stencilling

Based on original ideas from Surfrider Foundation (USA and Australia).

Protocol and PR

Successful drain stencilling campaigns are now underway in Brisbane, Melbourne and Sydney. Local authorities and ministers have given the green light for this community based activity to go ahead.

However use these examples to obtain local council approval before stencilling your local drains.

Method

1. If you are making your own stencil out of cardboard you do not need to apply quick release agent. Figure 147.3 gives some ideas for stencils.
   - For commercially available stencils (Figure 147.1) you need to apply PVA so that the paint can be cleaned off after use.
2. Some guidelines for promoting good public awareness:
   - Discuss the effectiveness of spraying signs in pollution prone areas.
   - Use paint with a brush in preference to a spray can.
   - If you use a spray can do not spray near cars or places where overspray can cause damage (that's the paint that blows in the wind).
   - Stay as a group, don't take off on your own.
   - Take your time and do a good job. Remember you are not in school/college now and are environmental ambassadors for the community, trying to create awareness to a serious environmental problem.
3. Find an approved piece of roadway and clean off the dirt.
4. If you are using a spray can, spray a little bit first, until you get a feeling of how the spray comes out.
5. When people come up and talk to you, explain that you have council permission and that you are involved with public education of drains.
6. If you haven't already done so, design a stencil or banner that can be used in a public education program.

Materials and equipment (per group)

- drain stencil (available from Surfrider Foundation or Wet Paper), alternatively make your own from cardboard and a paper cutting knife
- gloves
- 1 can of PVA (poly vinyl alcohol) to help clean the stencils after use. This is the quick release agent used in the fibre glass industry.
- spray paint - at time of publication commercial grade paint was available from Dy-Mark (check yellow pages for local phone numbers)
- yellow linemarking paint with which you could try a roll-on system also

  If you are going to design your own stencils then have them approved by your school and local authority before spraying or painting

Figure 147.1 Drain spray gear as used by the Brisbane City Council

Figure 147.2 Home made stencils used by Surfrider Foundation

Create a caption

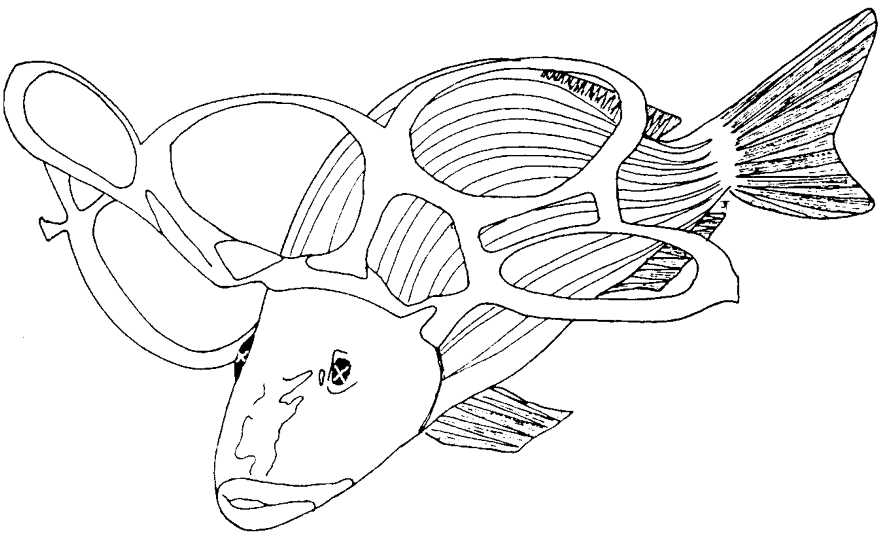


Figure 146.3 Ideas for drain stencils and posters (Illustration of seal and fish by Jan Thornton Sea World)

Exercise 147 Audiovisual materials list

Method

Here is a list of each of the following materials and addresses. Write to each asking the current price including freight.

Page/s	Item	Supplier	Address
20	Information sheet 3	CSIRO	Marine Lab GPO Box 1538 Hobart 7001
30/276/274	Coastal Studies textbook	Wet Paper	14 Milbong Tce Ashmore 4214
34	Bolting silk	Swiss screens	4/14 Randall St Slacks Creek 4127
44/276/294	Video - Sand nourishment to the rescue	GCCC	PO Box 5042 GGMC Bundall 4217
54	Video - Planning for the inevitable	AMSA	PO Box 1108 Belconnen ACT 2616
55	Brochure - Marine oil pollution	Qld Transport	GPO Box 2595 Brisbane 4001
96	Textbook - Mangroves in Focus	Wet Paper	14 Milbong Tce Ashmore 4214
98	Seagraas brochure	GBRMPA	PO Box 1379 Townsville 4810
100/102	Textbook - Mangroves in Focus	Wet Paper	14 Milbong Tce Ashmore 4214
104	Bolting silk	Swiss screens	4/14 Randall St Slacks Creek 4127
126	Brochures Coral Polyp and the Soft Touch	GBRMPA	PO Box 1379 Townsville 4810
158	Mangroves and estuaries	Bob Hardie	PO Box 200 North Tamborine 4272
168	Artemia shrimp	Australasian pets	Commercial Rd Fortitude Valley 4006
178	Turtles brochure	GBRMPA	PO Box 1379 Townsville 4810
182	Whale booklet	Whale Centre	PO Box 190 Victor Harbour 5211
182	Whale brochures	Sea World	PO Box 190 Surfers Paradise 4217
208	Aquaculture project sheets	Nick McMorrow	Pioneer State High School Mackay 4740
214	Booklet - Australian Ships	Centre for Ecc Dev.	PO Box 334 Albert Park 3206
216	Ecotourism Video Kit	Greg McGarvie Ent.	PO Box 3304 North Mackay 4740
226	Protecting our seas brochure	AMSA	PO Box 1108 Belconnen ACT 2616
226	Stow it don't throw it brochure	AMSA	PO Box 1108 Belconnen ACT 2616
247	ESD – A to Z booklet	Total Env Ctre	1/88 Cumberland St. Sydney 2000
257	Zoning plan maps - local area	GBRMPA	PO Box 1379 Townsville 4810
264	Video - Green Bells	Surfrider Foundation	PO Box 444 Mermaid Beach 4218
270	Video - Port Lincoln Fishing Industry	Port Lincoln APEX	PO Box 626 Port Lincoln
272	Oil and gas booklet	Petroleum institute	500 Collins St Melbourne 3000
272	AMOSC Oil spill brochures	AMOSC	305 North Shore Geelong 3214
274	Fisheries Resources Book	P. Kailola	PO Box 3841 Manuka ACT 2600
278	WaterWatch Manual	ANCA	GPO Box 636 ACT Canberra 2600

Figure 147.3 Table to work out cost. Students may make one copy of this page so that they can attach their answers before handing in for marking. Teachers do not have permission to make class sets of this page for inclusion in a booklet

Subject Index

Equipment Index

The following is a guide to source or help build new equipment.

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