Marine Science

For Australian Students

3rd Edition

SAMPLE PAGES

Bob Moffatt
Tim Ryan
Leon Zann

Photo Viewfinder Australia

Contents

Part A Oceanography

Part B Marine biology

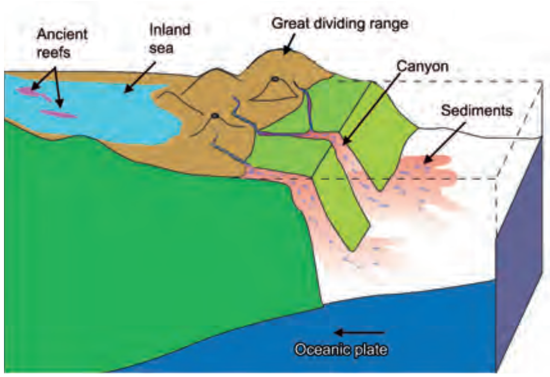
Part C Management and conservation

Photo Bob Moffatt

Sediments

Sediments ran off and covered areas in a deep trench which was later to be uplifted out of the sea to form coastal zones east of what now is the Great Dividing Range. The shallow sea had ancient reefs now found in the Kimberly (Figures 22.1 and 22.5)

This shallow seas also contained paleozoic animal and plant life which can be seen in road cuttings at many places in Eastern Australia (Figure 22.3) and formed the rich coal deposits of eastern Australia Figure 22.6. The old craytons rich in minerals were deformed into the rich mining deposits of Western Australia (Figure 22.2)

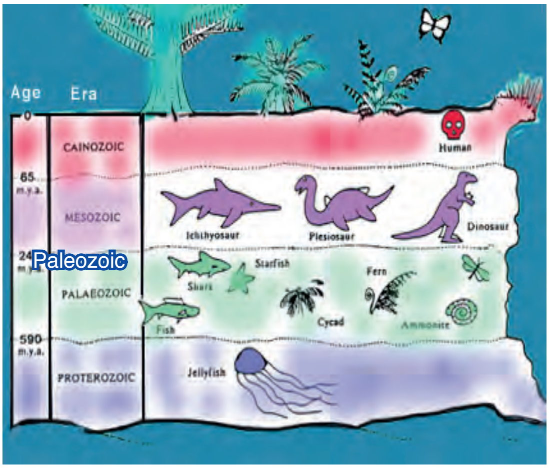


Bob Moffatt

Figure 22.1 Sediment run off

Ian Morris

Figure 22.2 The islands of the Buccaneer Archipelago, located in Western Australia, contain rich silver and iron ore deposits



(Illustration Queensland Museum)

Figure 22.3 Geological time as seen in a road cutting

Bob Moffatt

Figure 22.4 Cliffs of the Great Australia Bight which were once joined with Antarctica

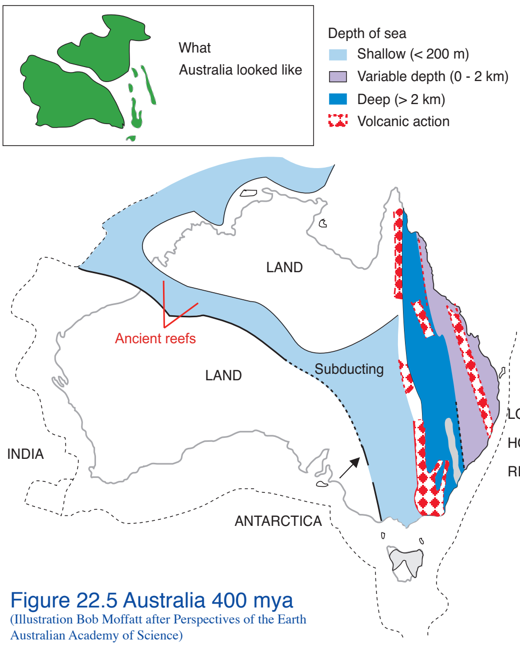


Figure 22.5 Australia 400 mya

(Illustration Bob Moffatt after Perspectives of the Earth Australian Academy of Science)

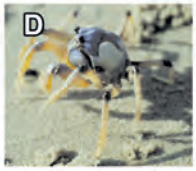
Mining Australia)

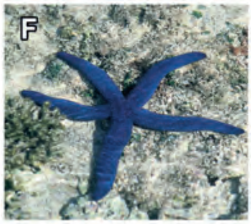
Figure 22.6 Shallow seas contained plant life which decomposed to form coal basins in Eastern Australia .

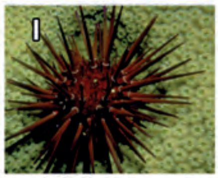
Exercise 11.2 Using a key

Aim

To use a simple key to identify the major marine phyla.







Method

- Use the key below to identify the creatures to the right.
- Note: This is not intended to be a key to all marine animals, but will enable the identification of most of the more common members of this kingdom. You may be able to find more complete keys and you will need to use these if you are to identify some rarer marine animals.

Materials

- Photographs of marine animals or range of preserved specimens.
- Key to marine life (see below).

Method

1. Use the key to marine life below to classify the animals into Phyla.
2. When classified write down the structural characteristics particular to the animals.

Key to marine life

1a. Body with no organs or mouth. Many small openings, fewer large openings. Spicules.

Sponges (Phylum Porifera)

1b. Not as above ... Go to 2.

2a. Radially symmetrical. Tentacles with nematocysts

Jellyfish, Corals, Anemones (Phylum Cnidaria)

2b. Not as above ... Go to 3.

3a. "Wormlike" shape, body divided into segments, bilaterally symmetrical.

Segmented worms (Phylum Annelida)

3b. Not a "wormlike" shape ... Go to 4.

4a. Hard exoskeleton, jointed legs.

Crabs, Prawns, Barnacles etc (Phylum Arthropoda)

4b. No exoskeleton (May be a shell) ... Go to 5.

5a. Radially symmetrical, tough spiny outer skin may be present.

Sea Stars, Sea Urchins, Sea Cucumbers (Phylum Echinodermata)

5b. Bilaterally symmetrical ... Go to 6.

6a. Soft mucus covered body, possibly in a shell.

Shellfish, Snails, Slugs, Squids etc (Phylum Mollusca)

6b. Backbone present, made of bone or cartilage.

Fish, Reptiles, Birds, Mammals (Phylum Chordata)

Establishing tests for salinity

Using light or electrical conductivity

Salinity is often measured by measuring how well electricity travels through the water.

This property of water is called conductivity. Water that has dissolved salt in it will conduct electricity better than water with no dissolved salt. The more salt that is dissolved in the water, the better the water conducts electricity.

The salt content of the water can be measured very precisely using the conductivity method (Figure 134.1).

A conductivity / TDS / Salinity Tester is used to check salt content and comes in a kit with a probe, battery, electrode soaking solution and conductivity standard solution.

The instrument gives a direct reading.

Using a refractometer

Salinity can also be measured with a hand held refractometer (Figure 134.2)

A refractometer measures the change of direction or bending of the light as it passes from air to water. Light moves slower in water than air.

The more salt in the water, the slower the light moves

A refractometer is the best choice for measuring salinity when only approximate values are needed.

Refractometers are easy to use in the field and relatively inexpensive. The salinity is read from a scale in the viewfinder (Figure 134.3)

Image courtesy
Select Scientific
www.selectscientific.com.au

Figure 134.1 A conductivity / TDS / Salinity Tester

Figure 134.2 A refractometer can also be used to measure salinity
Photo Red Sea

Figure 134.3 Salinity readings
Photo Red Sea

Temperature and sea water

Ocean surface temperatures vary from 28°C in the tropics to below zero at the poles. Figure 154.1A shows the surface temperatures in the Pacific Ocean. Figure 154.1B shows the temperatures of the Pacific depths (photographs courtesy NOAA).

The ocean surface can be heated by radiation from the sun, conduction of heat from the atmosphere or condensation of water vapour. The sea surface can be cooled by radiation back from the sea to the atmosphere, conduction of heat back to the atmosphere or evaporation.

Ocean currents can also transfer heat from one place to another.

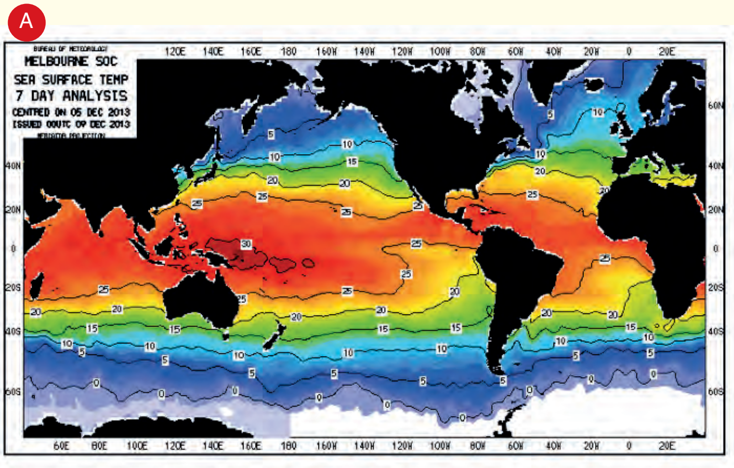
Colour references

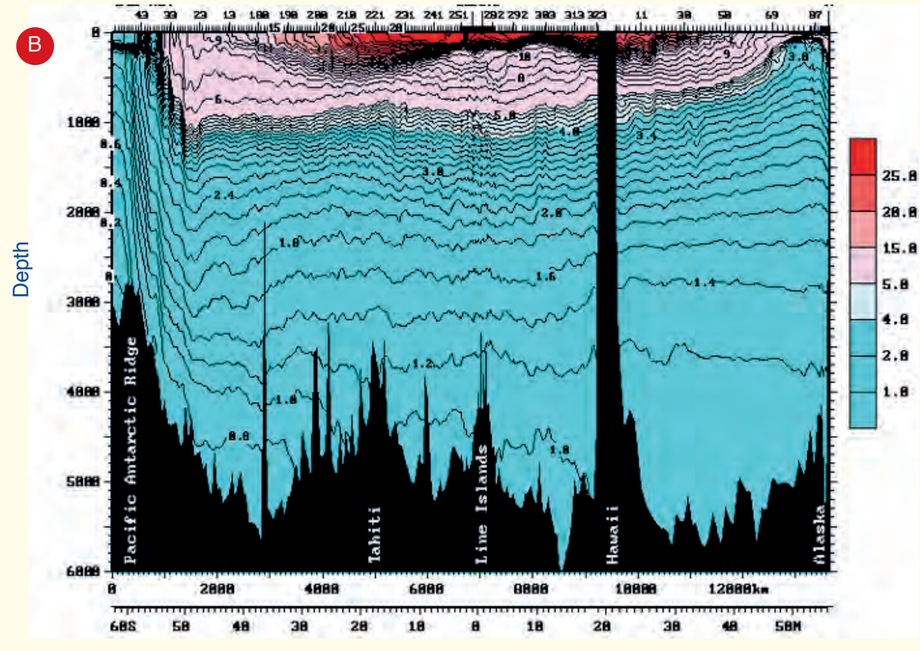
Try the following words in your search engine:
Pacific Ocean surface sea temperature

Biological significance of temperature

Animal migrations occur due to temperature. Whales migrate to warmer waters to calf. Corals spawn at certain temperatures and the composition and texture of marine animals and plants is governed by temperature. Animals that live on the rocky shore also develop protective coverings to compensate for temperature changes.

In recent times, coral bleaching (see Chapter 11) has been blamed on increased temperature changes.





Can you see the thermocline? See chapter 3 for more information on temperatures and currents.

Figure 154.1 Pacific Ocean potential temperatures. (Illustration A courtesy Commonwealth bureau of meteorology Illustration B courtesy NOAA)

Moreton Bay Marine Park
2009 Zoning map

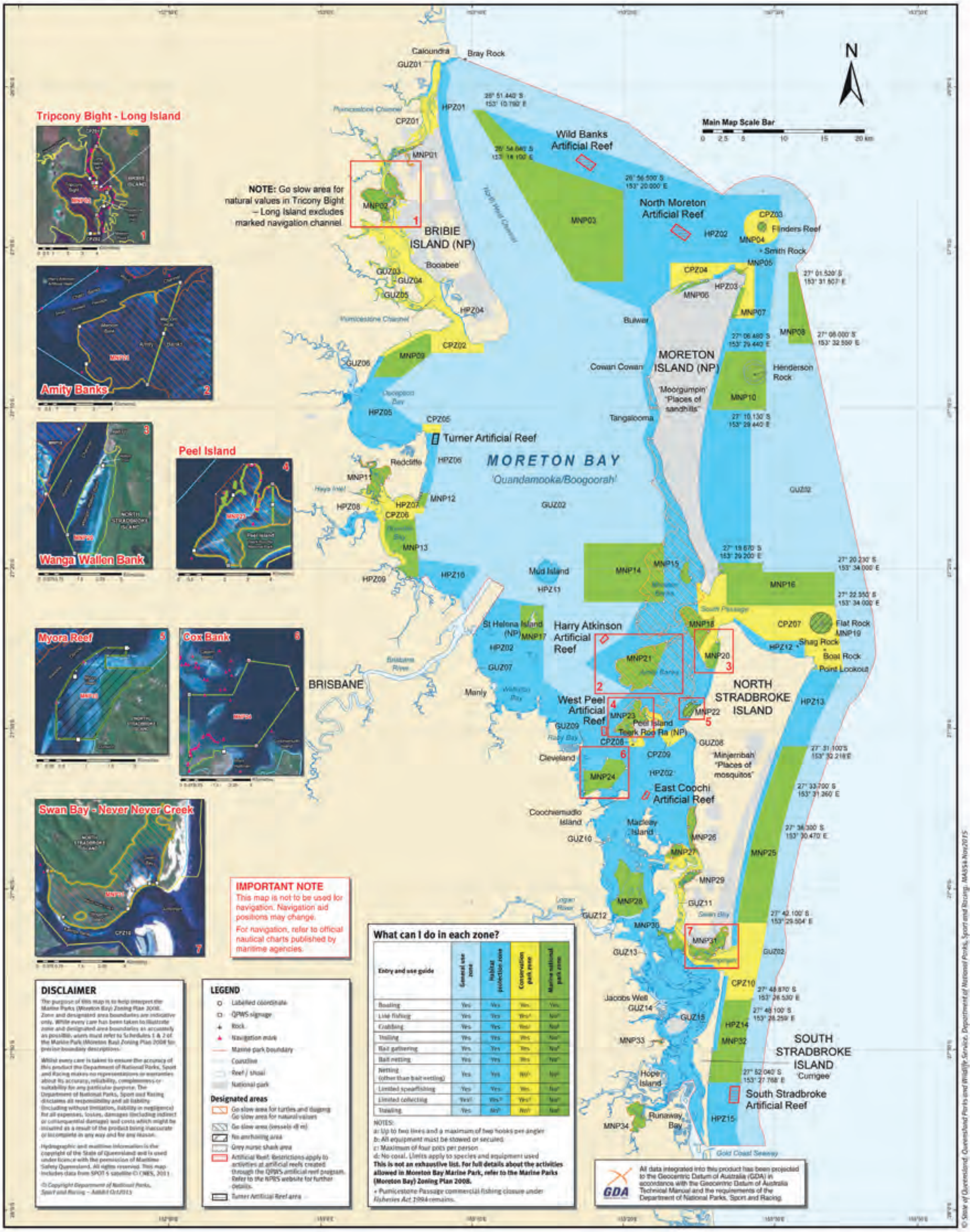


Figure 561.1 Moreton Bay Marine Park

(Courtesy EPA Queensland)

- data storage and analysis of information (using computer databases such as *Geographic Information Systems* GIS).

Australia's EEZ is vast and largely unexplored, marine ecology is a very complex subject, and marine research is time-consuming and very expensive. Quite often we don't know enough to answer the planners' questions. In these cases the ***precautionary principle*** dictates that they should err on the side of caution.

Environmental education: Important for community support

Figure 468.1 Snorkelling and diving are a great way to learn about the sea.
(Photo Len Zell)

It is important that Australians know about the marine environment, and the threats to it. Care comes from understanding. Once we understand the consequences of our actions, we will accept the reasons for controls, and can even develop ourselves better ways of doing things. ESD requires the support of the wider community and possible sacrifices in life-style. Public environmental education, particularly in subjects such as the one you are currently studying now, is essential so that future generations are better informed.

We live in the information revolution where we are bombarded with information by radio, newspaper and TV. The Internet is already a major source of information. The environment is frequently in the news. The sea is a popular subject on TV adventure stories and documentaries. Australians are becoming more environmentally aware. Public perceptions are being changed through education. Only a decade ago the shark was a feared man-eating monster. Now it is a graceful predator which should be preserved.

Figure 468.2 Environmental organisations try to educate the public.
(Photo Bob Moffatt)

Stakeholder involvement

Environmental management generally involves regulating the behaviour of particular industry or community groups involved. These are sometimes termed ***stakeholders***. It is now widely recognised that if stakeholders are to support a plan, they need to be well informed and actively involved. (In the past, governments generally passed laws, and then told people they must obey, or else! It was an unpopular approach, and not very successful.)

Figure 468.3 Student excursion to offshore island
(Photo Len Zell)

Water quality issues

Declining water quality is a significant issue. The catchments are heavily used and runoff of sediments and nutrients into the Bay is high. There are problems in the inner bay where the circulation is limited. Seasonal outbreaks of a toxic algae *Lyngbya*, which kills fish and causes skin irritations in bathers, are blamed on elevated nutrients. To improve water quality in the Bay, the Local Councils which control the catchments collaborated in a detailed study of the environment. This found that water quality near Brisbane was not good, but that in the eastern ocean side is excellent. The Councils combined to established *Healthy Waterways*, a body to better manage catchments, and there are already some improvements in water quality.

Conclusions

Moreton Bay is a unique area with high biodiversity value, but is subject to intense human uses. The Moreton Bay Marine Park demonstrates the potential of multiple-use protected areas in areas of high usage. *Healthy Waterways* also demonstrates how a cooperative approach to catchment management is possible.


Bob Moffatt
Bob Moffatt
Bob Moffatt

Figure 563.1 Shipping is a major activity in Moreton Bay Marine Park.

Solitary Islands Marine Park (SIMP)

New South Wales has recently established three large, multiple-use marine protected areas: the Solitary Islands region near Coffs Harbour on the North Coast, Lord Howe island in the offshore Tasman Sea, and Jervis Bay on the South Coast. Another is planned for the Byron Bay area on the far North Coast.

The NSW Solitary Islands Marine Park (SIMP) extends 75 km north from Coffs Harbour to the 3 mile limit, and is over 70,000 ha in area. Commonwealth waters beyond 3 miles increase its size to almost 100,000 ha.

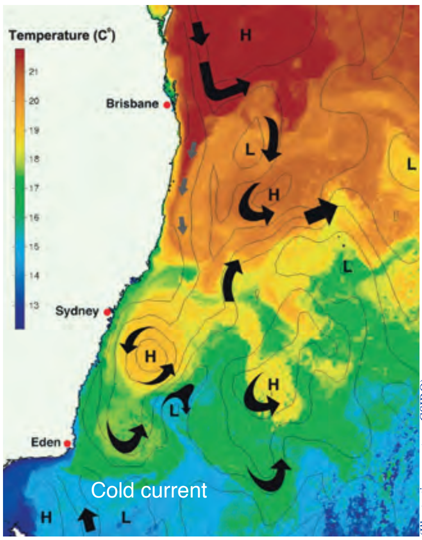

Lord Howe Tourism

Figure 563.2 Ball's Pyramid & Lord Howe Island

Biodiversity values

The SIMP region includes many different habitats: estuaries, beaches, rocky shores, shallow and deep continental shelf sediments and rocky reefs, supporting salt marsh, seagrasses, mangroves, and intertidal, algal, coral and sea floor communities. The Solitary Islands lie in a tropical/temperate overlap zone, or 'ecotone'. They are bathed by the strong East Australian Current (Figure 563.3) which brings warm tropical water and tropical larvae from the south Pacific and Great Barrier Reef region. This current meets the cold southern water around the Port Stephens area, and is diverted into the Tasman Sea, bringing warm water and larvae to Lord Howe Island, the southern-most coral reef in the world.

The subtropical coral reefs are unique. They are dependent on the warm east Australian Current, and are few in number, small in size and are very widely separated (many by hundreds of kilometres). They occur at the lower temperature limit of coral growth and do not grow fast enough to form reef structures. They are made up of a mix of tropical and cold water species but are dominated by a few specialist subtropical corals.



(Illustration courtesy CSIRO)

Figure 563.3 Currents off Coffs Harbour

Exercise 8.4 Simpson's Biodiversity Index

Based on original ideas by Nancy Tsernjavski and Angela Colliver

A community dominated by one or two species is considered to be less diverse than one in which several different species have a similar abundance.

Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, so diversity increases.

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

n = the total number of organisms of a particular species
N = the total number of organisms of all species

The value of D ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity.

- To calculate Simpson's Index for Hypothetical Bay, two areas (natural vegetation and disturbed vegetation) were sampled using quadrats placed randomly or systematically. The number of plant species within each quadrat, as well as the number of individuals of each species should be noted. There is no necessity to be able to identify all the species, provided they can be distinguished from each other.
- As an example, let us work out the value of D for a single quadrat sample of ground vegetation in the Hypothetical Bay dunes. Of course, sampling only one quadrat would not give you a reliable estimate of the diversity of the dune flora. Several samples would have to be taken and the data pooled to give a better estimate of overall diversity.

  The method used to optimise the sampling is the Optimum Quadrat Size technique.

Species	Number (n)	n(n-1)
Spinifex	2	2
Goats foot	8	8
Sea oak	1	0
Banksia	1	0
Wattle	3	6
	N=15	$\sum$ n(n-1) = 64

- Now put the figures into the formula for Simpson's Index above

Answer

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

$$D = 1 - \left(\frac{64}{15(14)} \right)$$

Simpson's Index of Diversity = 0.7

Group discussion

Form groups of about 5-6 and use the poster on Page 213 as a discussion starter to answer the questions below.

Questions

1. The poster depicts a range of marine organisms in various habitats spanning coastal dune to intertidal zone, rock pool, reef and open ocean, through the zone of light and into the zone of perpetual darkness.

   What does your group think of the graphic, its characteristics and setting in attempting to explain species diversity?
   a. Make a list of the types of animals and plants you can identify.
   b. Classify them as best you can using the tree of marine life (Page 207).
   c. Make a list of the external features for each organism.
2. What is the difference between genetic, species and ecosystem diversity? Use the illustrations in the graphic to give an example of each.
3. Use the key on page 202 to devise a new key for the vertebrates shown in the graphic.
4. Draw up a two column table with temperate and tropical as headings. Now list under each heading where you think the animals and plants in the graphic would be found.
5. Study the images on pages 214 - 215 .
   a. Make a copy of each illustration and draw food webs for each.
   b. Using the tree of marine life, classify into animal and plant groups each of the marine organisms shown.
   c. Draw up a table to distinguish between the four different ecosystems shown.
   d. For each ecosystem, make a list of at least 4 individuals not shown.
6. Explain this statement:

   Food webs are one important type of interaction, but species can provide an attachment base for other species, can alter current or light patterns, provide camouflage or other forms of shelter or compete for space. (See page 210, para 5, for context).
7. What are the five kingdoms of marine life depicted and what characteristic/s separates them from each other?
8. Name one or more animals from the following groups in the illustration; Mammalia; Reptilia; Osteichthyes; Chondrichthyes; Amphibia; Mollusca; Cnidaria; Arthropoda; Mollusca; Echinodermata; Plantae.

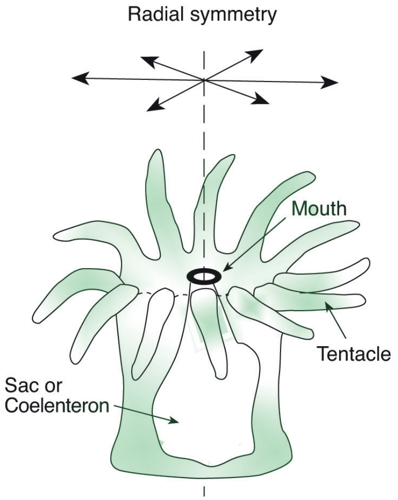


Figure 276.1 Cnidarians are radially symmetrical.
(Illustration Bob Moffatt)

Phylum Cnidaria

Sac-like animals with body plan arranged in a circle and a sac at one end, two cell layers, stinging cells. Includes animals such as corals and sea jellies.

External features

These animals are radially symmetrical, with a simple body in the form of a sac or coelenteron with one opening or mouth as shown in Figure 276.1.

Animals can be either attached by means of a basal disc to form a polyp (eg corals) or may drift in the water as a free swimming medusa such as sea jelly (Figure 276.2).

Medusae have a bell with balance organs known as statocysts and tentacles located below the bell Figure 276.2.

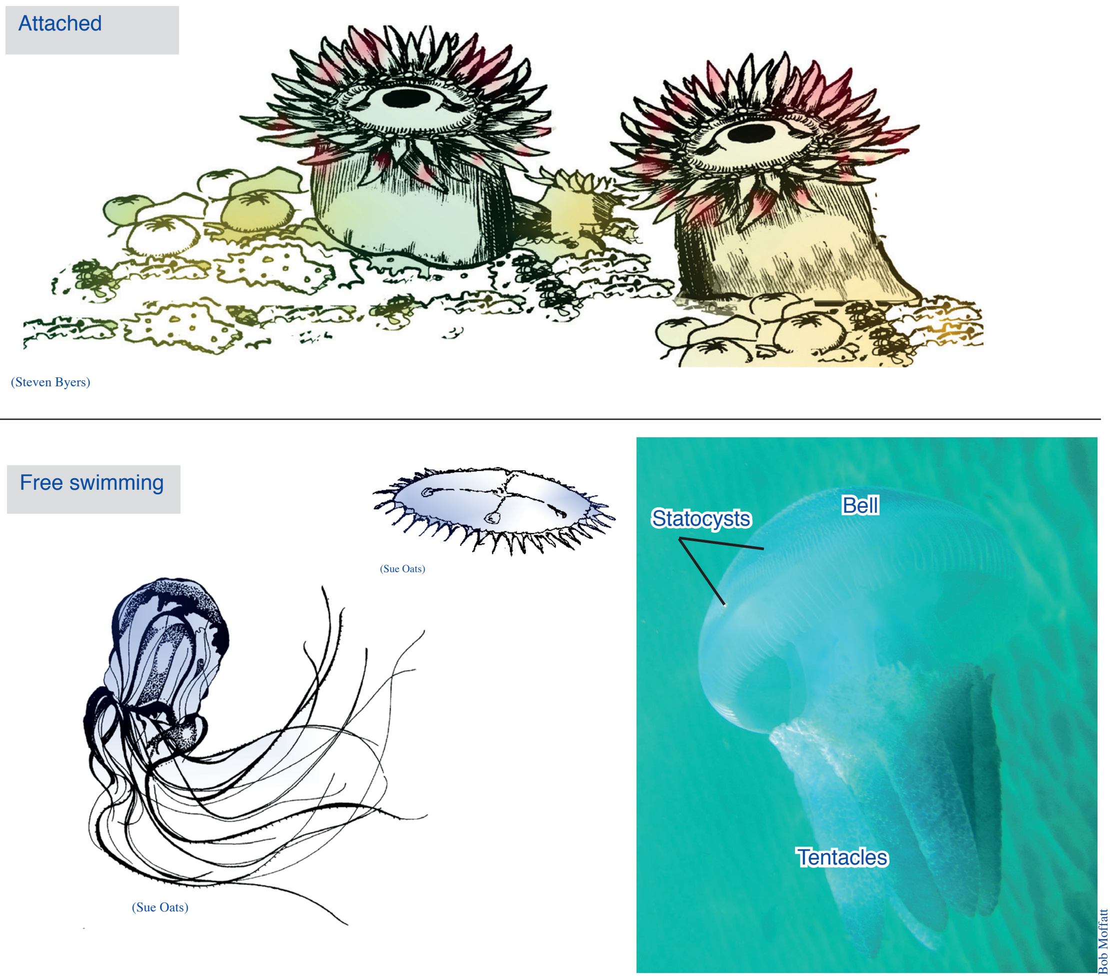


Figure 276.2 Animals can be either free swimming or attached.

Feeding

The mouth is surrounded by a ring of tentacles (Figure 277.1) on which special stinging cells called nematocysts are found. Nematocysts are for feeding and defence and are the characteristic which gives the phylum its name.

Figure 277.2 a and b shows how these specialised cells fire. The venom from the nematocysts of the sea wasp box jellyfish are extremely painful and fatal in many cases.

Figure 277.1 Mouth and tentacles
(Murray Waite)

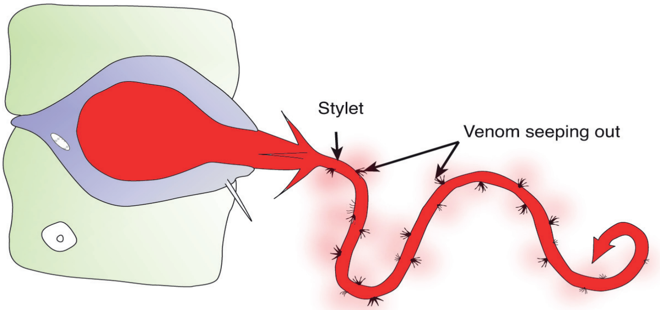


Figure 277.2a Nematocyst discharged
(Bob Moffatt)

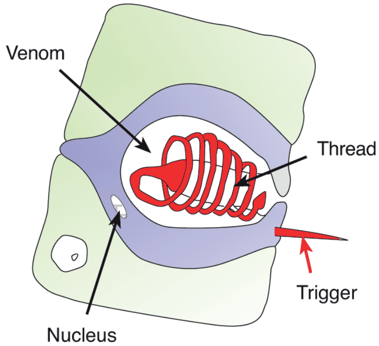


Figure 277.2b Nematocyst undischarged
(Bob Moffatt)

Reproduction

Reproduction is complex among Cnidarians with both asexual and sexual forms. In corals, the most common asexual means is by budding where another coral polyp grows as bud from the parent polyp resulting in a new animal that is genetical identical to the parent.

For genetic diversity, sexual reproduction is needed and in corals this is a spectacular event in November each year.

Inside the polyp the male and female sex organs develop which produce sperm and egg (Figure 277.3). Fertilization in some corals is internal producing an egg bundle which is released through the mouth. These fertilized eggs disperse and grown into a planula which settles to the ocean floor to grow into a juvenile and finally back into an adult.

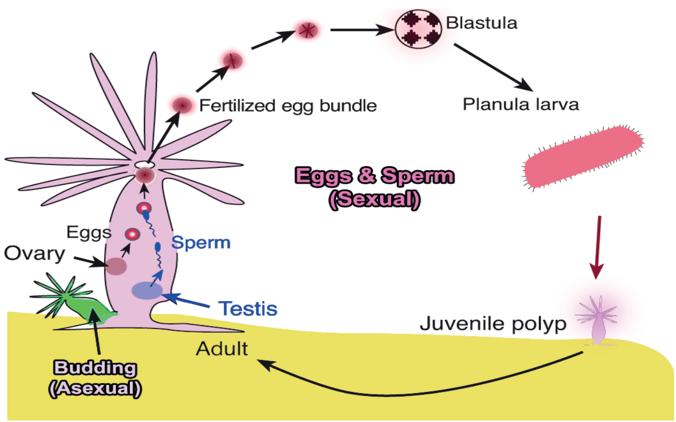


Figure 277.3 Coral reproduction
(Illustration Bob Moffatt)

(Photo courtesy Peter Harrison JCU 1988 Reproduced with permission.)

Class Hydrozoa

Bluebottle

Blue bottles form colonies of specialised individual cells as shown in Figure 279.1 and are often confused as jellyfish. Each group of cells performs a different function: feeding, digestion of food, reproduction. Even the float is a group of cells designed for floating.

The bluebottle gets its name from the colour and shape of its body which looks like a blue, sail-shaped balloon up to 25 cm long. The trailing tentacles are up to 10 m long (over 30 feet), which makes them hard to avoid especially in strong currents or large waves. Although not fatal in most cases, the sting causes severe pain and welts on the skin. *Vinegar should not be used on blue bottle stings as it increases irritation - use only cold water and ice to relieve the pain.*

Other hydrozoans include the fireweed and stinging hydroids.

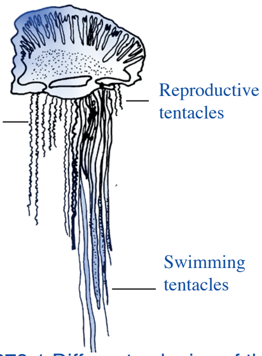


Figure 279.1 Different colonies of the blue bottle
(Illustration Bob Moffatt)

Figure 279.2 Blue bottle
(Photo Neville Coleman)

Class Cubozoa

Box jellyfish

Box jellyfish, also known as sea wasps, are the deadliest stinging jellyfish in the world and have killed swimmers, adults and children, off northern Australian beaches. They have large, transparent, bell-shaped bodies up to 30 cm across, each with a large, trailing clump of tentacles up to 4 m long, containing millions of nematocysts.

Preferring warmer waters, they are found only in the tropical waters of Australia's far northern beaches between December and March. Beaches from Cairns around to Broome are closed for swimming during this period.

Victims, especially children, usually die within minutes of being stung after suffering intense pain followed by paralysis (caused by the poison shocking the heart) followed by breathing failure. The poison also attacks the red blood cells in the victim's skin upon contact and produces large, purple, whip-like marks.

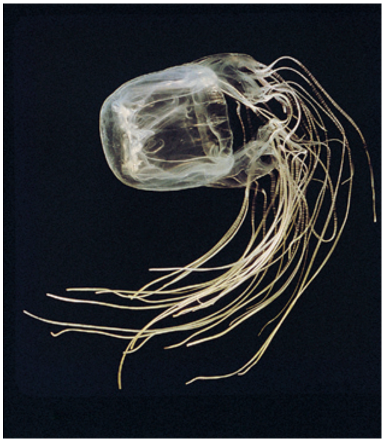


Figure 279.3 Box jellyfish
(Photo Neville Coleman)

Irukandji

These are small members of the box jellyfish family with a bell size of about 2 cm. This means they can pass through stinger nets. Although the sting is very minor the pain which develops later can be excruciating. *If stung in Northern Australia, flood the area with vinegar and get to hospital within 20 minutes for pain killers.*

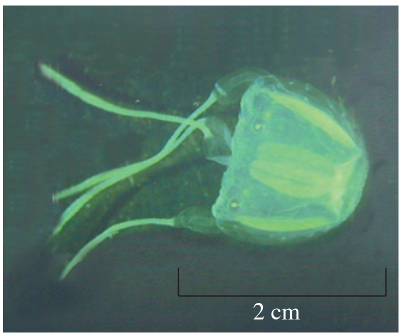


Figure 279.4 Irukandji
(Photo Jamie Seymour)

Treatment for box jellyfish and Irukandji

1. Flood the area stung with vinegar.
2. Seek medical assistance as fast as you can.

Web: Search engine word — Irukandji
http://www.reef.crc.org.au/aboutreef/coastal/irukandji.html
http://cnsfse01.jcu.edu.au/schools/tropbio/cubozoan.html

Figure 280.1 A sea anemone
(Photo Mike Sugden)

Class Anthozoa

Sea anemones

Sea anemones illustrate some of the features of the phylum Cnidaria. The body plan is arranged in a circle with two cell layers and stinging cells on the tentacles (see Figure 280.1).

The tentacles are connected to a mouth which leads down to a hollow gut (the coelenteron) which is where food is digested (Figure 280.2). Wastes are then ejected out of the mouth. Sea anemones can move by sliding on their basal disc or by somersaulting from place to place. They reproduce by growing small buds on their sides or by producing eggs and sperm from inside their gut.

They can also retract during low tide or to eat their prey using strong retractor muscles located in the body wall.

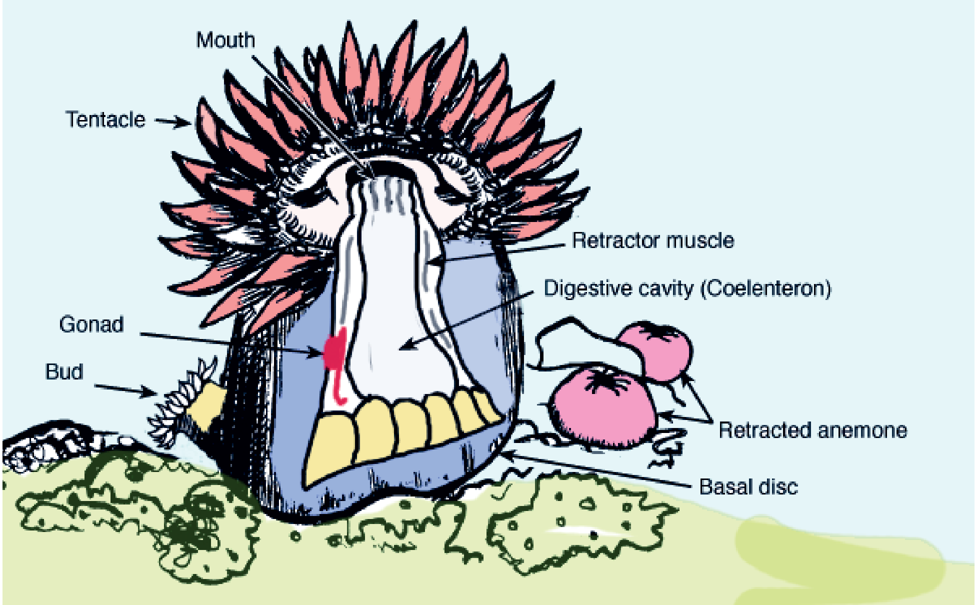


Figure 280.2 Sea anemone internal structure

A special relationship

Some anemones have a symbiotic relationship with clownfish. These fish hide amongst the tentacles to avoid predators.

They can do this because a coating of mucous protects them against the nematocysts of the anemone.

The fish benefit by having a safe place to hide and in return the clownfish chases away fish which feed on the anemone eg butterfly fish. This type of symbiosis is called mutualism and is discussed further in Chapter 15.

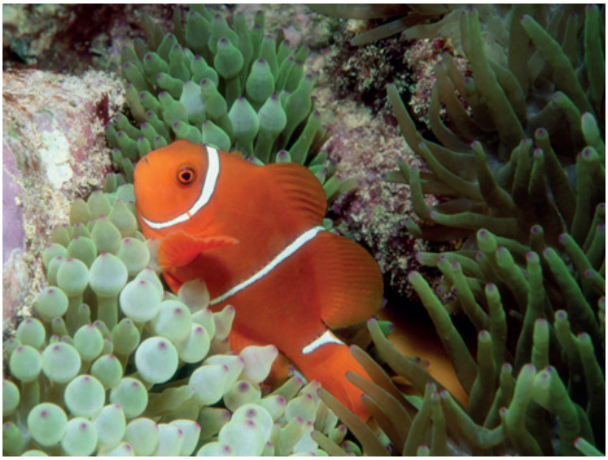


Figure 280.3 The anemone and the clownfish form a symbiotic relationship called mutualism.
(Photo Murray Waite)

Corals

The only living thing that can be seen from outer space is the Great Barrier Reef. This reef is made by individual coral polyps that secrete a calcium carbonate base when they grow. When the animal dies, this is left behind for new coral polyps to grow on, so coral reefs are made of dead coral with a thin veneer of living corals and animals on the outside.

Corals need specific requirements for growth and scientists from the Great Barrier Reef Marine Park Authority have identified the following four main requirements:

- clear water so they can get necessary light,
- low nutrients,
- stable salinity and
- hard surface to grow on.

Few reefs grow next to the mainland because the water quality is too poor caused by high sediment runoff and other pollutants from land.

There are two types of coral — hard and soft.

Soft corals and sea fans

Soft corals lack a hard skeleton and protect themselves by secreting chemicals called terpenes. These make them toxic to predators.

Soft corals have eight fringing tentacles with each tentacle having side branches giving it a feathery appearance (Figure 281.1).

Sea fans

Sea fans are like soft corals but the coral polyps are supported by an substance called gorgonium. They often protrude out from coral bommies like the ones shown in Figure 281.2.

Hard corals

Tourist operators commonly classify hard corals by their appearance as either boulder, branching, plate, table, vase, or solitary — see Figures 282.1 - 7 over.

Figure 281.1 Soft coral
Bob Moffatt

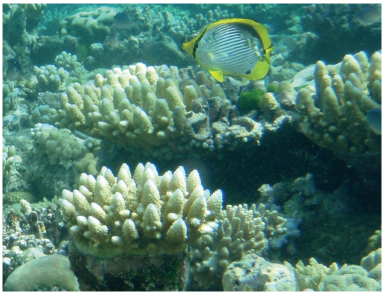


Figure 281.2 Hard coral
Bob Moffatt

Figure 281.3 Sea fan
(Murray Waite)

Questions

1. Make a table of the structural characteristics that separate the protozoa, porifera and cnidaria.
2. Give example of animals from each of the phyla mentioned above.
3. Distinguish between corals and sea anemones.
4. Describe the life cycle of an animal from the class scyphozoa.
5. How does a sponge get its food?
6. Describe the special relationship between the clownfish and the anemone.
7. What's the treatment for a box jelly fish sting?
8. What's the signs and symptoms of an Irukandji sting and what treatment would you recommend to a tourist if stung?
9. How do corals reproduce?
10. Draw a diagram of a cross-section of a sponge showing the relationships between the various cellular layers.
11. Distinguish between the medusa and polyp stage of a cnidarian giving an example.
12. Discuss possible reasons for considering the Protozoa as the most basic form of life.
13. What is phagocytosis and how is it important to the Protozoa?
14. Compare and contrast the digestive processes of sponges and jellyfish.
15. Mutualism is one form of symbiosis - name two others (see chapter 15).

Figure 282.1 Soft coral
(Photo Bob Moffatt)

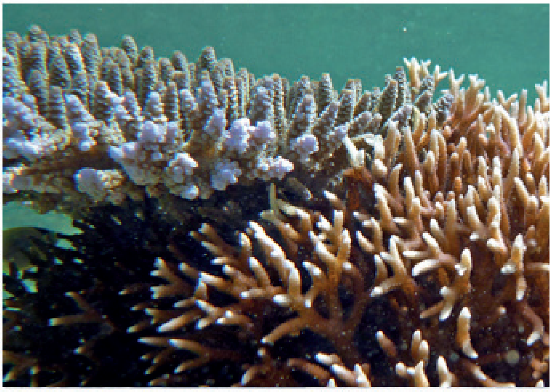


Figure 282.2 Branching coral
(Photo Bob Moffatt)

Figure 282.3 Boulder coral
(Photo Underwater Realms)

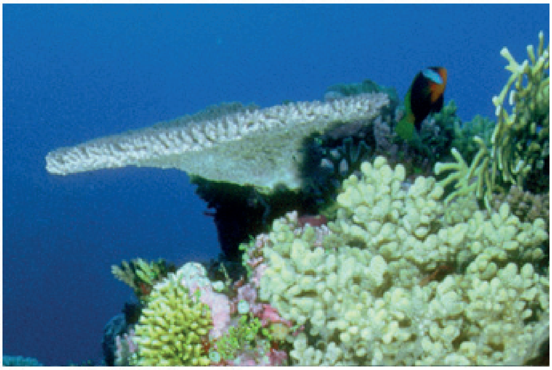


Figure 282.4 Table coral
(Photo Murray Waite)

Figure 282.5 Solitary coral
(Photo Bob Moffatt)

Figure 282.6 Vase coral
(Photo Murray Waite)

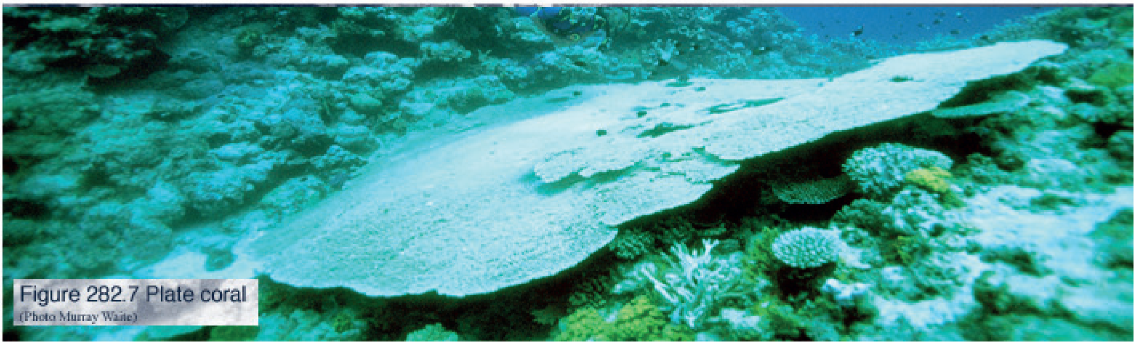


Figure 282.7 Plate coral
(Photo Murray Waite)

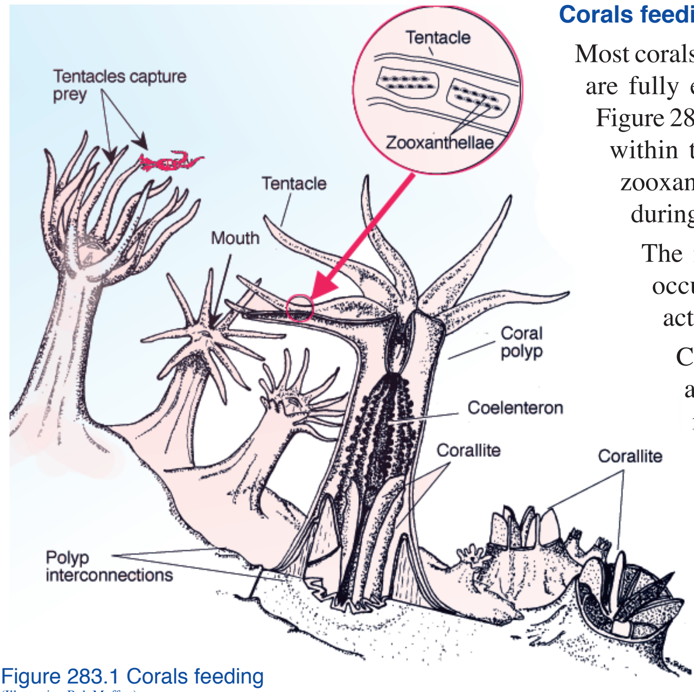


Figure 283.1 Corals feeding
(Illustration Bob Moffatt)

Corals feeding

Most corals feed at night, and at this time their polyps are fully extended in search of food as shown in Figure 283.1. During the daytime they are retracted within their corallites. This maybe because the zooxanthellae produce enough food for the coral during the day, or they retract to avoid predators.

The night feeding pattern of corals probably occurs because zooplankton reefs are most active at night.

Corals feed by extending their tentacles armed with nematocysts and catching microscopic plankton that pass by (Figure 283.1). When the tentacle encounters an animal such as a shrimp, the barbed darts of the stinging cell are fired into the flesh of the prey, killing it instantly. The prey is then forced into the animal's mouth and into the coelenteron where it is digested. Once the food has been broken down and absorbed into the polyp's tissue, some of the nutrients are passed to other polyps by the interconnections that join with other polyps.

The limestone base is added slowly as a result of the polyp absorbing calcium carbonate from the seawater as shown in Figure 283.2.

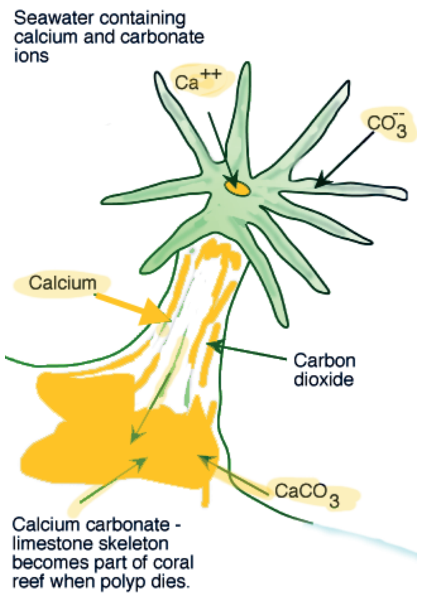


Figure 283.2 Coral colonies secrete a limestone skeleton as they grow by extracting calcium and carbonate ions from seawater.

$Ca^{++} + C0_3^{-} \rightarrow CaC0_3$

(Illustration Bob Moffatt)

Algae and corals

Reefs are not made entirely of coral. Algae play a very important role in the production of hard calcareous (calcium type) materials, which helps cement sand, coral pieces as well as living and dead material together to form the reef.

Algae also play another important role in promoting coral growth. Corals are carnivorous animals, but they also obtain some nourishment from the plant cells embedded in their tissues. The success of corals as reef builders is due in part to the remarkable association with these tiny single-celled algae called zooxanthellae as shown in Figure 283.1.

***Symbiosis - mutualism + +** (see also page 406)*

The relationship is one of mutual benefit or symbiosis. The plant cells gain a suitable place to live, (like other plants they harness energy from sunlight to manufacture materials necessary for their own nutrition and reproduction). They also use the waste products of the coral polyp for nutrition and growth. The polyp gains oxygen, and between 70-90% of body sugars from the zooxanthellae.

During the day, reef-building corals usually have their polyps retracted into their limy skeletons. This allows the microscopic plants to absorb as much light as possible.

brought far more money into the area than commercial landings ever did. In 2002 in NSW, money from recreational fishing licences was used to buy out the professionals from 29 estuaries. Some 400 professional fishers were paid to leave the industry. This has caused loss of jobs and considerable personal hardship. Professional fishers warn that the general public will suffer as fish prices double.

Commercial fisheries — fishing for profit

Australia's commercial fishing industry ranks fourth amongst the nation's rural food-based industries. Total landings are about 220,000 tonnes, worth $2 billion, a year. Some 200 marine species are caught, of which prawns, lobster, abalone, scallops, oysters and tuna are most important. Finfish (sharks and bony fish) make up more than 60% of landings by weight, but the high value invertebrates like abalone, prawns and crayfish provide 75% of the earnings.

Australian fishing industry

About 27,000 people are employed in the commercial fishing industry, and there are more than 9,000 commercial fishing boats. Most are small, under 10 m in length, and owner-operated. Deepwater trawlers and long-liners are much larger, over 15 m in length. The latter are generally owned by larger companies, and are termed *industrial* fisheries. A number of large foreign fishing vessels, from Japan, New Zealand and other countries, are also licensed to fish in Australian waters. Some others fish illegally.

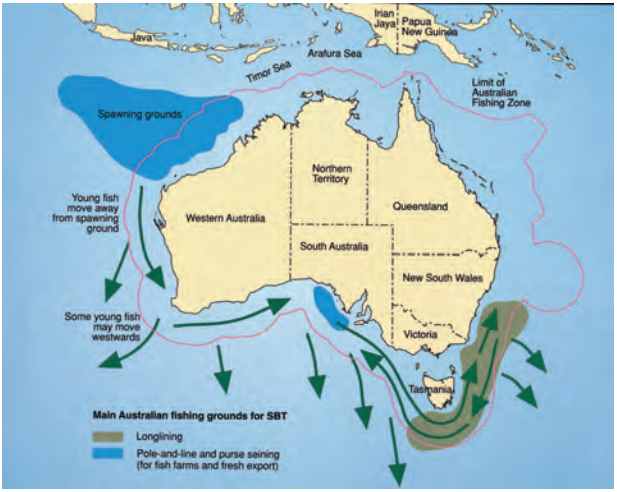


Figure 517.1 Australian tuna fishing grounds
(Illustration from SOMER 1996, reproduced with permission)

Exercise 20.2 Survey of your class fishing practices

Do you ever go fishing? Share some of your tales about the 'ones that got away'. Set up a table to show the following information for your class using fishing frequency as the main identifier. Use at least 4 groupings based on how often class members fish.

Write a two page essay on recreational fishing in your area. Use the following questions as a guide.

a. How many of the class go fishing each year?
b. About how many times?
c. How does this compare with the average local fishing family?
d. What fishing gear do they use?
e. Where do they fish?
f. What do they fish for?
g. On average, how many fish do they catch?
h. What is the most common catch?
i. Would they be willingly to pay $25 a year for a fishing licence if the money went in to managing the fishery?

Figure 517.2 School fishing class
(Photo Geoff Jensen)