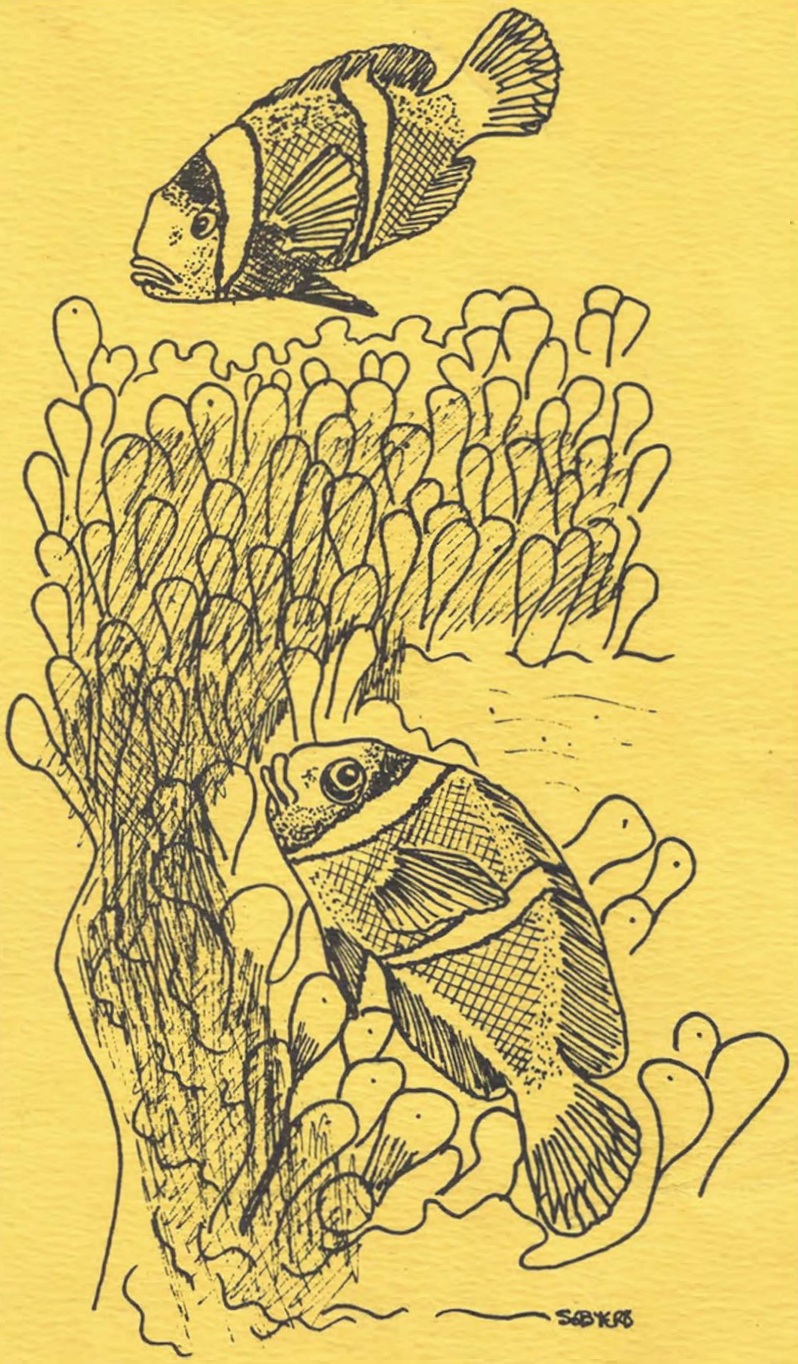
THE BARRIER REEF WORLD



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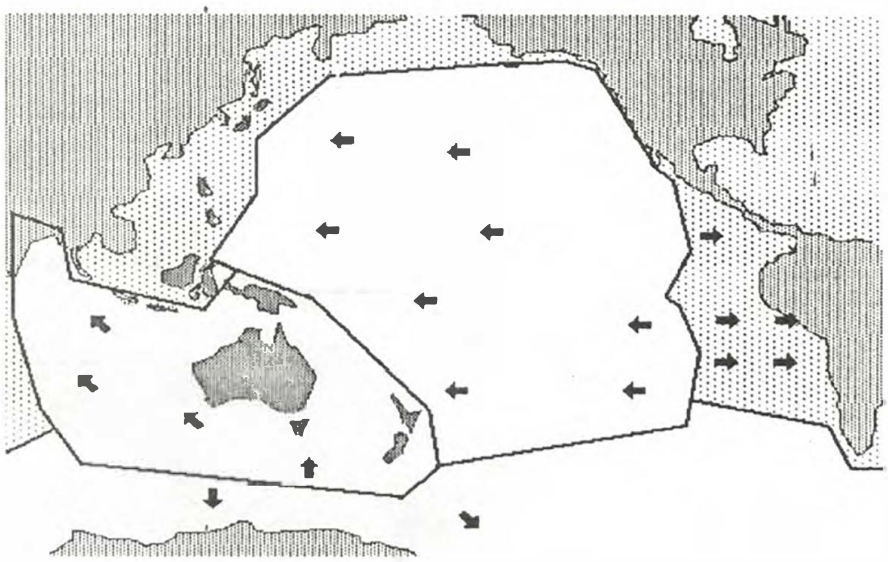
REEF FORMATION



SOME BASIC GEOLOGY

The earth is composed of a crust and a core separated by a mantle.

Inside the core is magma or molten larva which can force itself to the surface in volcanoes under the sea and on the land.

The continents of the Earth are positioned on continental crust.

At the bottom of the sea oceanic crust has many features not seen on the land.

Continents, like Australia, are said to "float" on the mantle because they are made of less dense rock.

The region between this rock is called the Moho which marks the region between the crust and the mantle.

This is about 40km under the continents but only 5km beneath the oceans.

The oceanic crust is therefore much thinner than the continental crust.

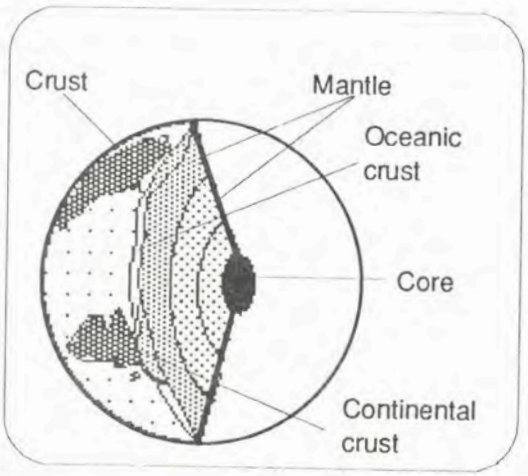


Fig 1: General composition of the earth

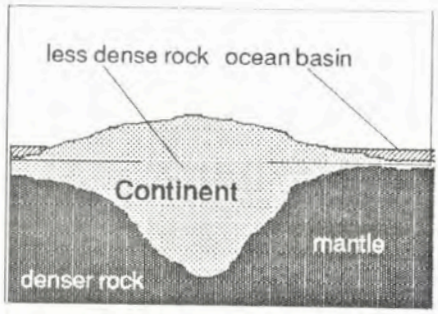


Fig 2: Continental crust material "floats" on the underlying mantle

In the Pacific, some features are:

* Islands, like Hawaii
* Deep Ocean basins, between continents and islands
* Continental shelves, bordering continents like Australia
* Oceanic ridges which form where magma forces itself out of the earth and forms a solid ridge. This occurs around the Pacific.

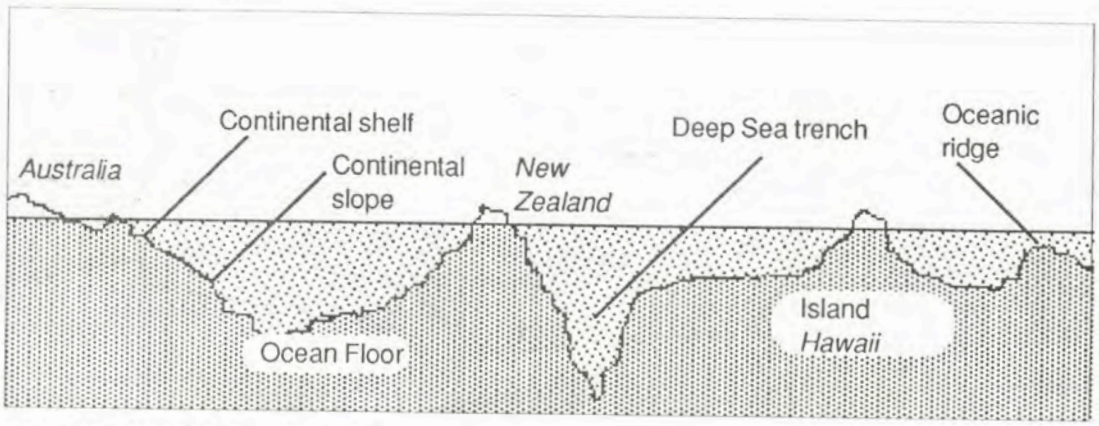


Fig: 3 Profile of the Pacific (not drawn to scale)

THE CONTINENTAL MARGIN

A closer view of the continental margin reveals a number of distict areas.

It is on one of these areas, the continental shelf, that our Great Barrier Reef was formed. Other areas include:-

* the continental platform
* off shore islands and reefs
* the continental slope
* the deep sea floor
* the mainland
* estuaries

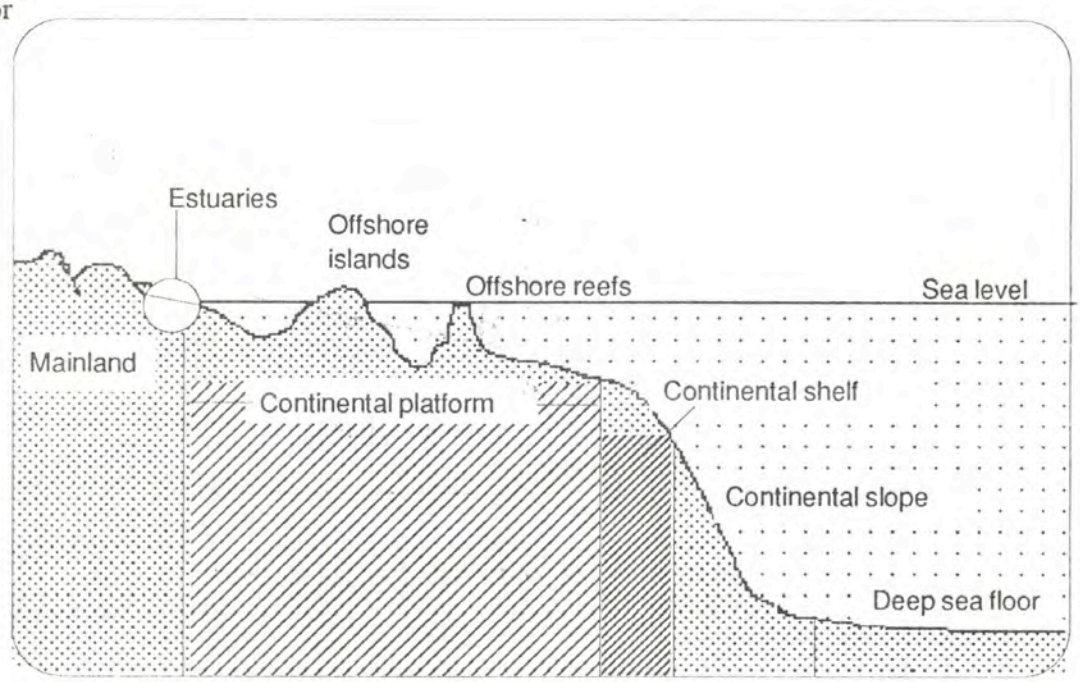


Fig 4: Cross section of the continental margin

To fully understand how and more importantly, when our reef formed it is important to understand how the nature of the Pacific.

THE NATURE OF THE PACIFIC

The Pacific ocean is large. It is surrounded by many countries, (the most important to our discussion being India, Australia, Antartica, New Zealand, North and South America.)

Each of these countries rests on a plate on the crust. The plates are bordered by

* **Ridges** on one side where the magma if forced up from the mantle

* **Trenches** on the other, where the plate dissapears below the continent

The plates are in motion. They move away from the ridges and towards the trenches.

There are three main plates in the Pacific. These are:

(1) The Indian Plate
(2) The Pacific Plate
(3) The Antartic Plate

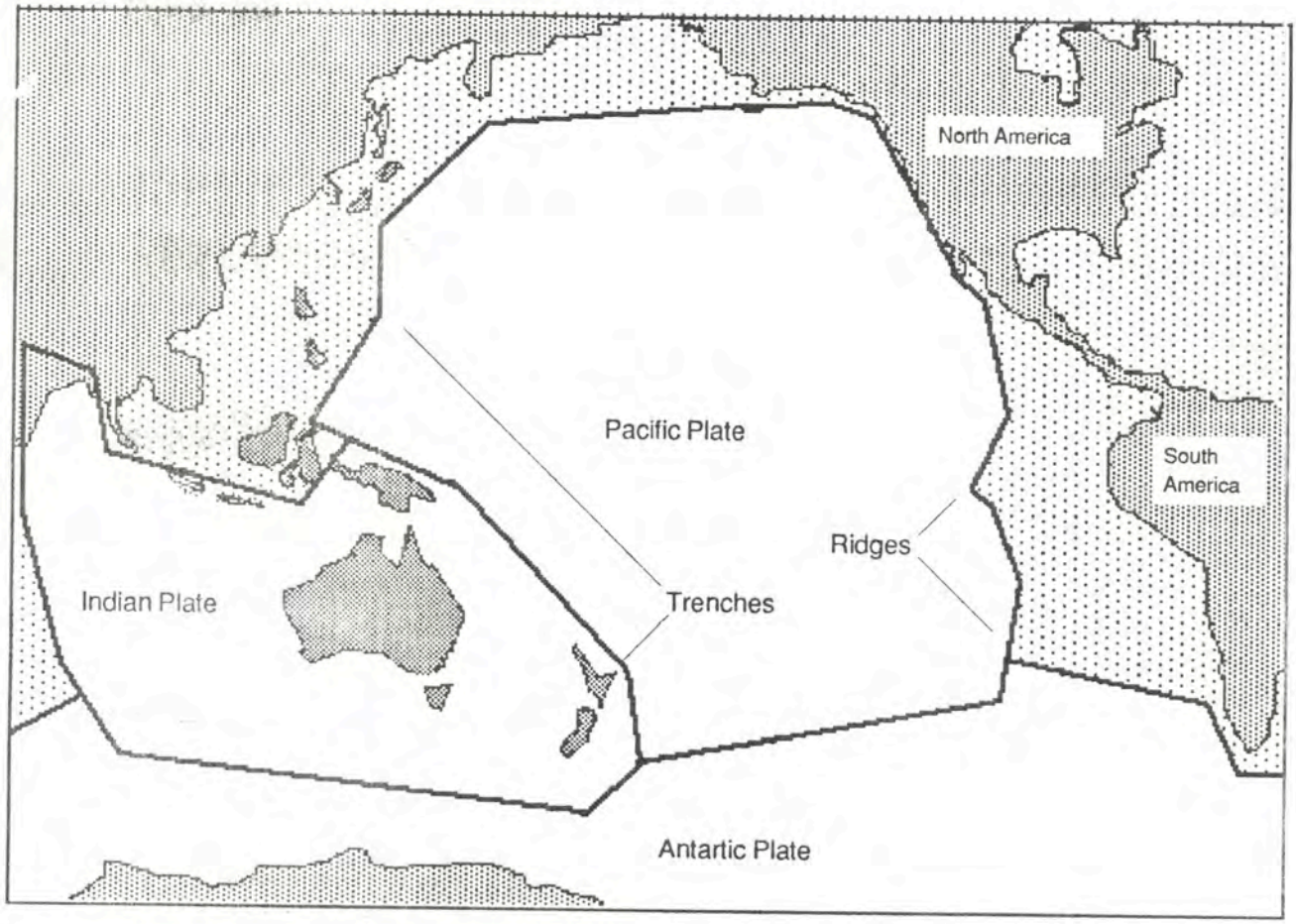


Fig 5: Schematic diagram, not drawn to scale, of the three plates of the Pacific

As mentioned earlier, these plates are bordered by trenches and ridges, (see Fig 5 above)

The molten lava *(magma),* moves to the surface from the mantle, it solidifies quickly because it is under the sea.

Pressure builds up, pushes the ridges up and out, causing the plate to move.

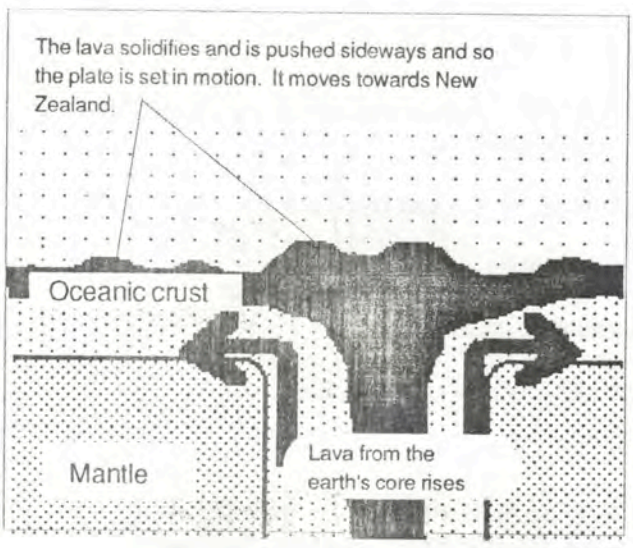


Fig 6: Schematic diagram of Mid Pacific Ridge

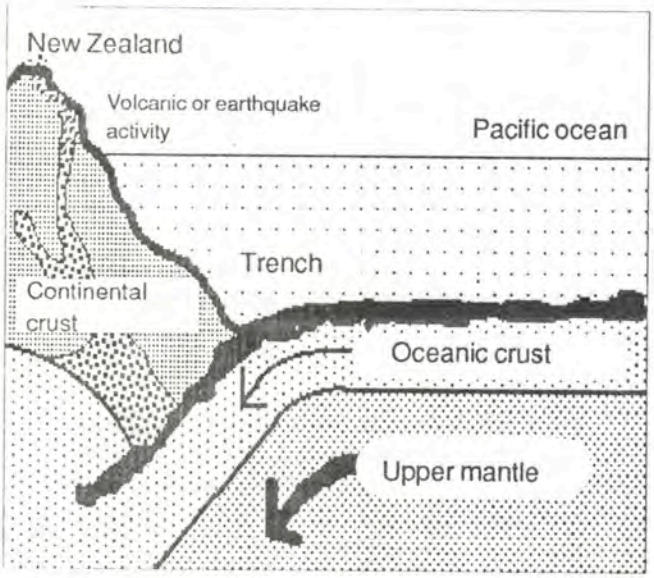


Fig 7: As the Pacific Plate moves towards New Zealand it dissappears under the continent in the trench

Fig 8: Record of the major earthquakes in the Pacific 1961 - 1967 at 0-710m depths. Compare this with figure 5.

Figure 9: Postulated movements of plates based on the theory of plate tectonics.

Figure 7 shows what happens as the plate moves towards New Zealand. The less dense oceanic crust moves under the more dense continental crust.

This causes pressures to build up under the continent or island as the case may be.

Release of pressure in earthquakes or volcanoes is inevitable and it is thought that this is the reason for earthquakes around the world.

Figure 8, is a record of the major earthquakes from 1961 to 1967 taken at depths ranging from 0 to 710 metres.

The record of earthquakes seems to add weight to this theory.

The theory of plate movements is called the theory of Plate Tectonics.

It postulates that:-

"If magma forces itself up at ocean ridges then it can cause adjacent oceanic crust to move"

It follows that anything that is on that oceanic plate will move with it.

Figure 9 below shows the postulated movements of the three main Pacific plates

But where is all this leading us and of what relevance does it have to an understanding of the Great Barrier Reef?

An understanding of our history is important to the realisation of how the reef formed and what were the events leading up to that formation.

A long time ago, 200 million years in fact, all the continents were joined into one supercontinent called *PANGEA*.

It is believed that pressures in the earth caused cracks to appear in this supercontinent and magma pushed the continents apart.

The first ocean ridge formed.

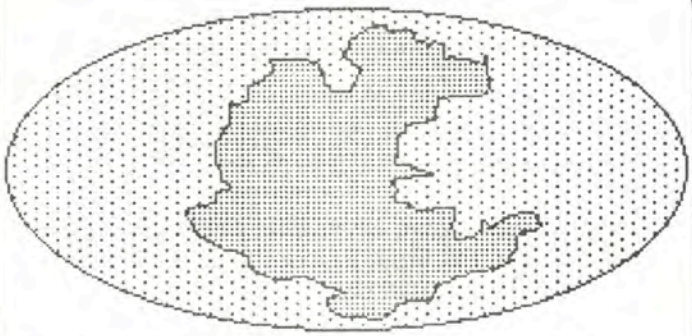


Fig 10: About 200 million years ago the present day continents formed a super continent called *Pangea*

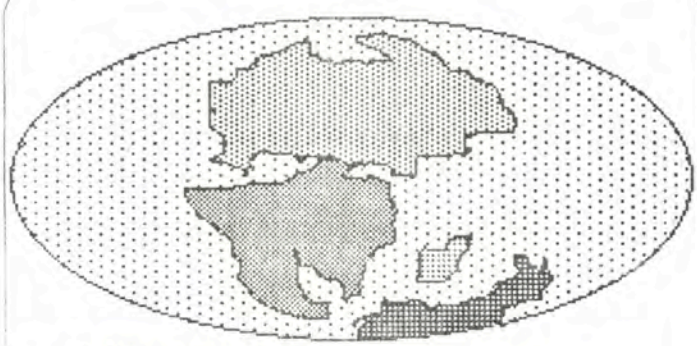


Fig 11: 100 million years ago and the supercontinent starts to break up. Africa and America are still joined.

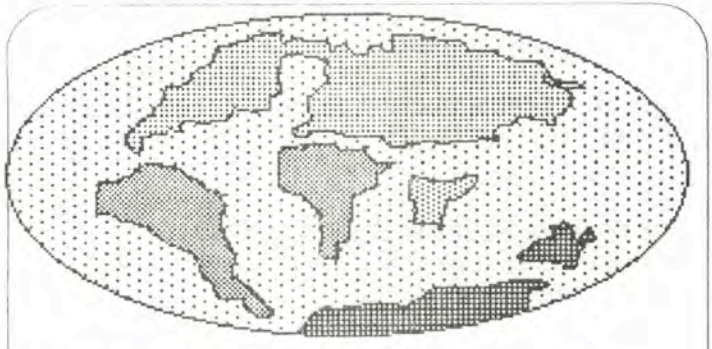


Fig 12: About 50 million years ago and Australia breaks free of Antartica. Africa and the Americas have separated.

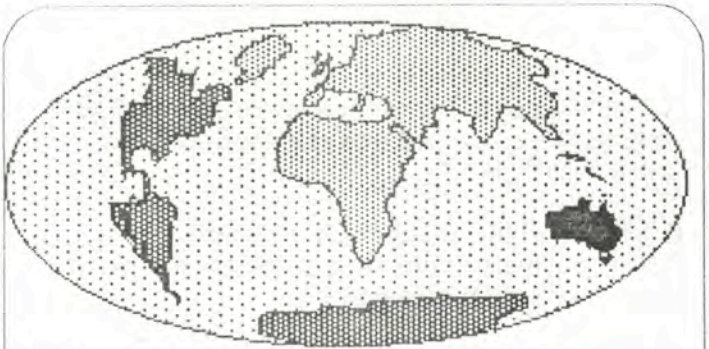


Fig 13: The Earth today , showing the approximate positions of the continents(not drawn to scale)

EVOLUTION OF THE OCEANS

The theory linking the present day features of the oceans - particularly the ridges and trenches with other geological evidence - is called the *theory of plate tectonics.*

This theory was developed in the early 1960's and is now widely regarded as the best possible explanation for the origin of the shapes of the oceans.

Plate tectonics says that all the earth's floors are spreading, being pushed apart along the ocean ridges. New ocean floor is continually being created by lava welling up from cracks at the centre of ridges and solidifying. (Figure 6)

The existing ocean floor is in movement as part of a larger system of movement of plates which makes up the whole of the earth's surface.

As the plates move, they not only pull away from each other at the ridges, but push towardss each other at either side.

When this happens, one plate moves under the other at ocean trenches and beside continents that have a less dense continental crust (Figure 7).

Sometimes the movement is not all that easy and pressure builds up on the plate. This pressure is released in the form of earthquakes and volcanoes and makes for an interesting discussion.

You can read about this in in another edition of this series called, "Oceanography".

Class Activity:

Review the video:

Volcanoes, Published by Educational Media, Australia, 1987 so as to review the main concepts of plate tectonics.

WHY IS ALL THIS SO IMPORTANT?

It is important to realise that Australia was not in the position it is today.

It therefore was not in a position that was conducive for coral growth.

Corals can grow at a wide variety of latitudes. Corals can be found in New South Wales and Victoria, but the coral reefs that are to be investigated in this set of notes are limited to Latitudes of about 20° and below.

An attitude towards the nature of the Barrier Reef will ensure its survival or lead to its extinction.

Attitudes come from understandings and it is important to realise that the reef formed only very recently in Geological time.

But how recently and where did it form? What were the conditions under which it developed and was it all just a straightforeward developement. The next section deals with these questions.

GEOLOGICAL TIME

Perhaps the most important time for reef development was in the last 20 million years of the earth's development. But where does that fit into the scheme of things. This is summarized in the table below. Compare this information with that given in the table on the next page. It can clearly be seen that the formation of the reef was a recent event in Geological Time.

Table 1: Shortened version of the Geological Time Scale

Period of Geological Time	Approximate Time	Important events in the History of Life	Important events in the formation of the reef
Recent	6,000 years ago	Ancient human civilizations	present sea level reached
	12,000 years ago		Continental shelf fully submerged
	18,000 years ago		Ice caps began to melt
			Sea level starts to submerge coral reefs
	150,000 years ago	Aborigines came to Australia	last ice age, sea level 150m below present level
Pleistocene	3 million years ago	Appearance of Humans	Capricorn basin subsidence complete. Reefs grew on pre-existing high points of old reefs. Distribution of reefs largely dependant on river systems
Pliocene	10	Mammals fully established	Ice age causes reefs to die out
Miocene	18	Age of Apes	First corals grew on Barrier Reef

Table 2: Geological Time Scale (continiued from Table 1)

Period of Geological Time	Approximate Time million years ago	Important events in the History of Life
Oligocene	35 million years	Specialisation of mammals, sediments flowed from rivers onto the reef.
Eocene	55 my	Australian plate still moving north and fracturing
Paleocene	70 my	Expansion of mammals, coral sea forms, cato trough forms, foundations for Bowen Basin laid down
Cretaceous	140 my	Dinosaurs became extinct, Australia still joined to Antartica
Jurassic	200 my	First mammals and birds
Triassic	230 my	First Dinosaurs
Permian	285 my	Expansion of primitive reptiles
Carboniferous	350 my	Expansion of sharks and fish
Devonian	400 my	First Insects
Silurian	430 my	First land plants
Ordovician	500 my	First fish
Cambrian	600 my	First marine invertebrates
Precambrian	4600 my	The beginning of life in the Sea

REVISION QUESTIONS

1. Name the three main parts of the composition of the earth.
2. What is the name given to the part of the deep sea?
3. Why are continents said to "float" on the earth's crust?
4. Which is more dense, continental or oceanic crust?
5. What is the Moho?
6. Draw a diagram of a general section of a continental margin.
7. What are oceanic ridges and where do they occur?
8. What usually happens at trenches?
9. Name the three most important plates of the Pacific.
10. What happens at the mid Pacific ridge?
11. What is magma?
12. What can happen as the oceanic crust slides under the continentla crust?
13. What does the theory of Plate Tectonics state?
14. Of what significance is the records of earthquakes in the pacific?
15. What was the name of the first supercontinent?
16. In which direction does the Indian Plate move?
17. Which continent is on the Indian plate?
18. How many years did it take the oceans of the world to form?
19. Is it correct to describe a theory of continental drift? Why?

ASSIGNMENT 1: A MATTER OF TIME

Purpose:

To demonstrate the length of time it has taken to evolve the oceans and the continents into their present state and for you to make a record of the major geological events leading up to the formation of the Great Barrier Reef.

Materials

Three pieces of computer paper, pencil and ruler.

What to do:

Part A: *Complete the following instructions to make a Earth Time line*

1. At the bottom left hand corner, write in the scale: 15mm= 100My (million years)
2. Rule a line across the three sheets of the computer paper, 80mm down from the top. In the top half of the page write, "living events" and in the bottom half, "continental events"
3. Starting at the 15mm in, mark of lines at 15mm intervals.
4. At the far left on the first mark, write earth begins, -4,600 MY. Under the line write, earth congeals, solar system forms.. Now mark off in 15 mm spaces writing the years -4,500, - 4,400, -4,300 until you get to...
5. -3,900. Then write "oldest known rocks, Greenland", continue.... to...
6. -3,400, write first life, Procaryotic bacteria.....
7. -3,000., write Simple Blue green algae develop produce oxygen from photosynthesis.....
8. -1,400, write First anerobic blue green algae utilize oxygen, first eucoroytic cells and multicelluarplants
9. -1,000, write First Jellyfish
10. -700, write First Sponges
11. -570, write Corals develop, sea levels are high covering North America, Africa and Australia
12. Between -500 and -450, write ice age, sea level falls
13. Between -450 and -430, write ice melts, water level rises
14. Between -430 and -400, write Jawed fishes evolve, **Sea Level rises and Pangea Forms.**
15. Between -400 and -350, write Amphibians evolve
16. Between -325 and -300, write First Pine trees, Reptiles evolve
17. Between -280 and -250, write Mammals evolve, Pangea complete
18. Between -190 and -150, write Dinosaurs and Birds evolve, Pangea breaks apart, Africa and America break apart
19. Between -150 and -130, write Europe separates from North America and Atlantic Ocean widens
20. Between - 130 and -100, write Africa and South America separate
21. Between - 100 and -50, write India separates from Africa, Antartica and South America unlock Dinosaurs die off.
22. At the -50my mark, write Australia separates from Antartica
23. At the -20my mark, write first coral reefs form off Queensland coastline
24. At the 0 mark write todays date.

Part B: *Using table 1, complete the three sheets of paper for the periods of geological time.*

1. Use the table to find the times.
2. Rule lines down to mark the cut offs and write the periods in the spaces between the lines

Part C: *Use the cut outs from the copyright free sheet at the back of these notes to illustrate the movements of the continents.*

1. Cut out the sheets from a photocopy (Don't cut up the original notes!)
2. Colour in the final continents and work backwards with your colours to predict where the continents of the earth originally came from.

HOW OUR BARRIER REEF FORMED

THE MIOCENE

As coral grows it produces limestone.

Coral polyps combine Calcium and Carbonate ions to form limestone, Calcium Carbonate $CaC0_3$. Algae also helps with this process.

The limestone forms a hard base and is the white coral skeleton seen when coral dies. As the coral grows so does the size of the coral skeleton.

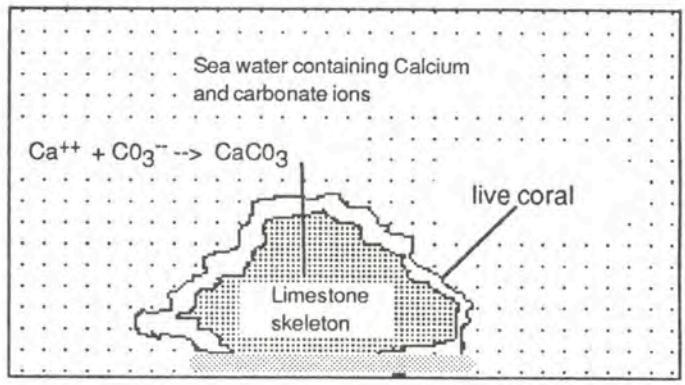


Fig 14: Corals secrete a limestone skeleton as they grow by extracting calcium and carbonate ions from seawater.

The foundations for the Great Barrier Reef were laid about 20 million years ago in the Miocene period, when the Australian plate had separated from the Antartic plate and was at a latitude where coral could grow in masses.

Two million years later the first coral reefs are believed to have been formed.

These grew steadily upwards until they reachered their present height about 150,000 years ago.

In Chapter 1, you learnt that the history of the reef is only a very short geological event.

The sequence of events that started the reefs' growth began almost 18 million year ago. Australia was at a latitude that promoted coral growth at a rapid rate.

As the sea levels rose, (Figure 15,) the corals began to grow in large numbers, forming a barrier reef on the outside of the continental margin.

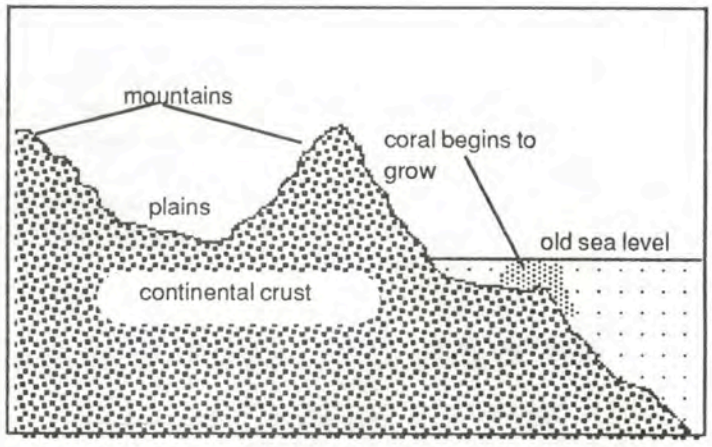


Fig 15: Australias continental margin in the Miocene- 18 million years ago.

The sea level gradually rose and with it grew the corals. (Figure 16)

There were still mountains and plains on the continental crust as the age of the mammals increased and the Australian marsupials were coming into their own.

THE PLIOCENE

As the sea level rose so did the reefs forming fringing reefs around the new islands and outer reefs on the edge of the continental shelf.

Life abounded in the seas and the islands became separated by large expanses of water. Populations of birds may have devloped because they no longer had many of their natural predators to compete with.

This continued throught he Pleistocene period up until a series of ice ages began.

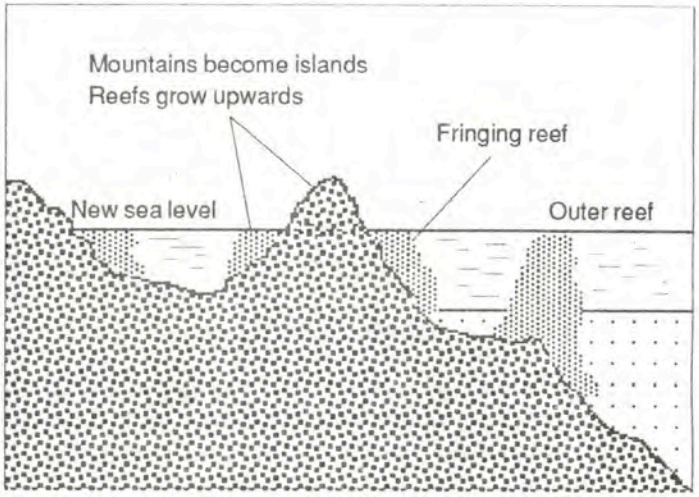


Fig 16: The Pliocene and Pleistocene periods.

THE RECENT PERIOD

When ice formed at the poles it concentrated the water. This meant that the sea level fell.

Although it is difficult to calculate, scientists believe this to be about 150 metres below the present sea levels.

These areas were now subjected to river systems and erosion. The limestone caves and cliffs were possibly the homes for our early aborigines. Trees and scrubs grew and kangaroos hopped around.

Figure 17 shows the build up of sediments from rivers. That accumulated when the area was covered by water.

Somewhere between 15,000 years ago and 10,000 years ago the ice caps from the last ice age began to melt. The water level gradually rose.

With the rising waters grew more coral, forming a thin layer over the old fossil reefs. Gradually this layer increased and thickness of 15 metres have been measured today.

The reefs as we now know them had formed.

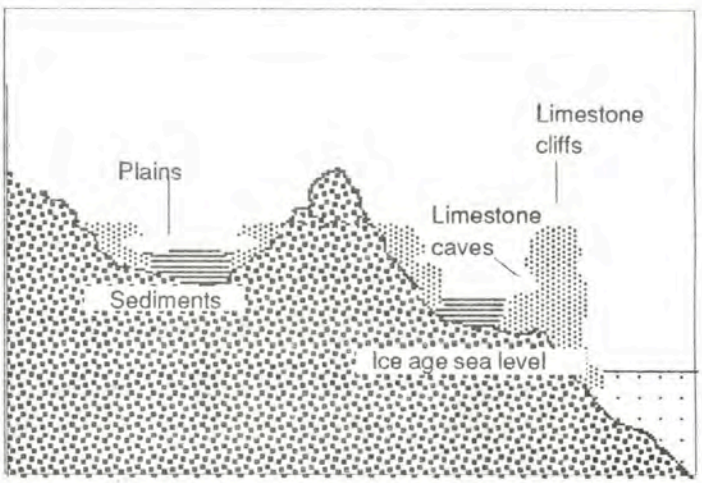


Fig 17: The ice ages left the coral reefs bare and open to erosion.

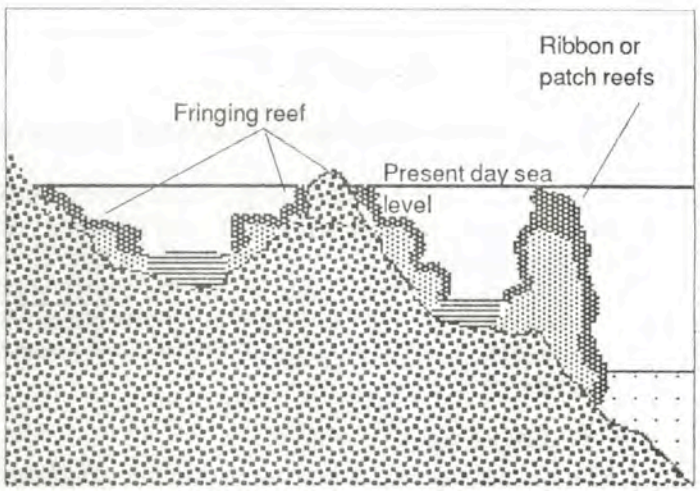


Fig 18: The reefs today are just a thin veneer on older fossil reefs.

SUMMARY CHAPTER 1

You should be able to recall the following facts and understand the following ideas:

(a) About the Earth itself

* The earth is composed of a Crust and a Core
* Inside the core is magma, molten lava, which can force itself to the surface in volcanoes under the sea and on the land
* The continents form continental crust and the bottom of the sea have oceanic crust

(b) About the Oceanic Crust

* Large blocks of oceanic crust, called plates, occur in the Pacific which are moved by the forces caused as the magma forces itself upwards
* The plates move in the direction of that force

(c) About the Pacific

* Earthquakes occur in regions where the plate subsides under Continents around the Pacific
* Deep ocean trenches are associated also with these regions (eg: New Zealand)
* Ridges occur in the Pacific where magma from the centre of the earth is gradually being forced upwards
* The Pacific Ridge extends off the east coast of New Zealand.
* Around New Zealand, volcanoes and earthquakes occur because the plates move under the continent here
* Features of the Pacific include:- continental margin, continental slope, deep ocean floor, mid Pacific Ridge and Islands

(d) About the formation of the Pacific its water levels

* The formation of the Pacific started a long time ago
  (a) 200 million years ago, (myo), the Pacific covered the rest of the globe because there was only one continent Pangea
  (b) 100 myo it was reduced in size because the continents started to drift apart because the magma forced itself up between the continents, splitting them and leaving room for water to flow into new seas
  (c) 50 myo, the seas were still growing and the continents were being pushed apart further
  (d) Today the margins of the plates give evidence to this theory
    * In more recent geological times, a series of ice ages occurred, with corresponding changes in sea levels

(e) About the conditions underwhich coral growth can occur

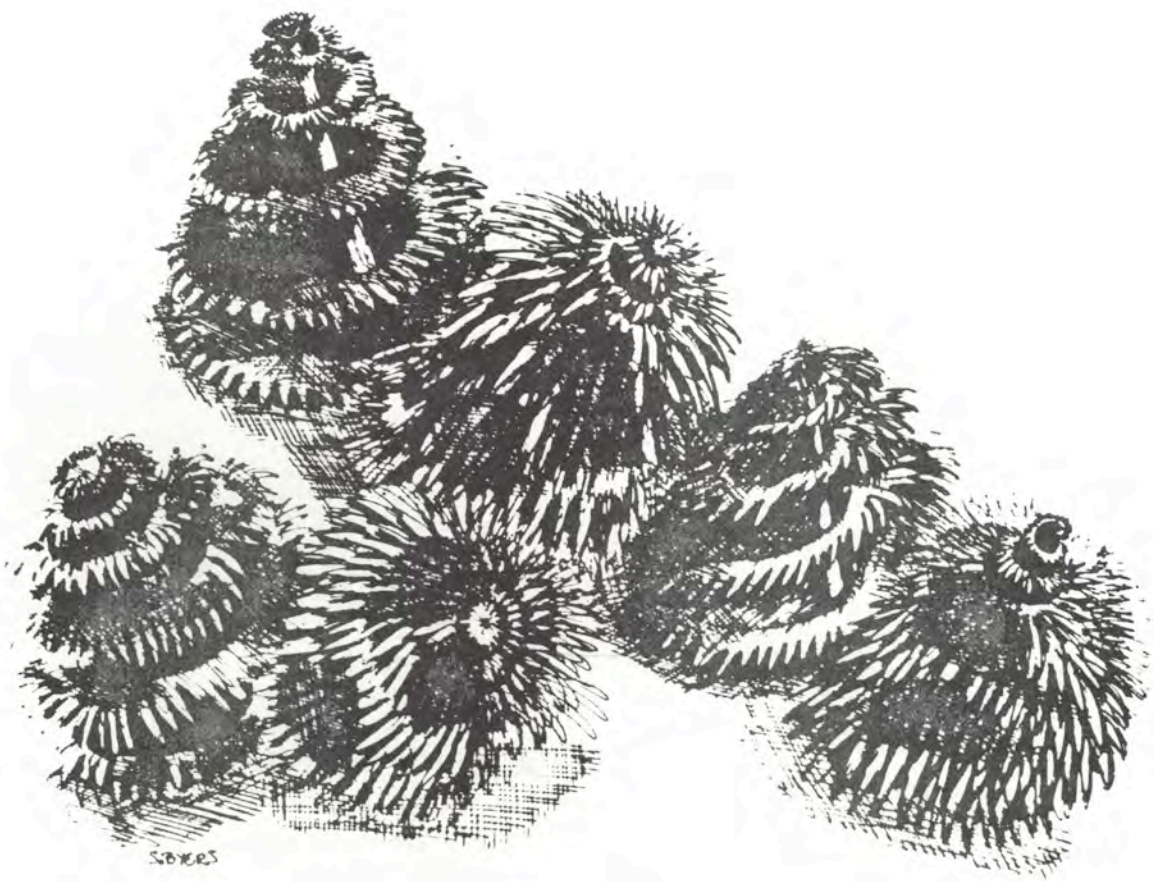
* Australia was not always at the latitudes that it is today
* Corals can occur at a wide variety of latitudes, but coral reefs are limited to latitudes of 20°
* As the Australian plate moved north, it may have passes over some hot spots, and caused volcanoes and other features leaving castes such as those found on Lady Elliott Island
* The Australian plate has been in its present position for only 20 million years
* A number of ice ages ocurred raising and lowering the sea levels causing corals to die off and regrow

(f) The final point is this:-

* The barrier reef is just a thin growth of coral over a very recent geological event, on a oceanic plate that is moving northwards at a rate of 4mm a year.

CHAPTER 2

REEFS TODAY



The Great Barrier Reef is not a single structure and should not really be called a "barrier reef".

It is made up of over 2500 individual reefs and as a reef province it is approximately 2000 kilometers long. As such it is one of the largest in the world.

In the north, chains of offshore reefs form a more or less continuous wall parallel to the Queensland coast.

Elsewhere reefs occur mainly as isolated offshore structures separated by large bodies of open water.

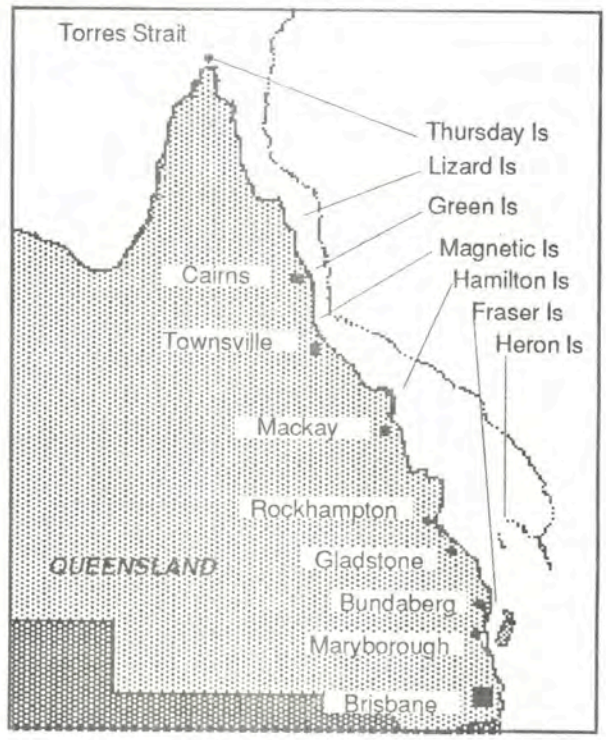


Fig 19: Australias Great Barrier Reef extends along most of Queensland's coastline

WHERE REEFS GROW

A reef begins to form when a shallow area of the sea floor within the tropics can provide suitable conditions to encourage and support benthic plant and animal colonization. Such conditions include the presence of a solid surface that is free from excessive mud and sand.

Sea water must be in relatively clear, warm, water having sufficent movement to circulate oxygen and plankton amongst the colonizing organisms.

As these plants and animals grow ever upwards and outwards they eventually die and their skeletons and shells accumulate and are cemented together by the calcareous algae.

There are many factors, such as tides, waves currents and salinity that affect marine organisms. Sea temperature is one important factor that may control where marine organisms are found.

As a result Australian coastal waters have been divided into a number of regions. Although there is some overlap between regions and although there may be great variety within a region, each region is marked by the presence of certain 'indicator species' of marine organisms.

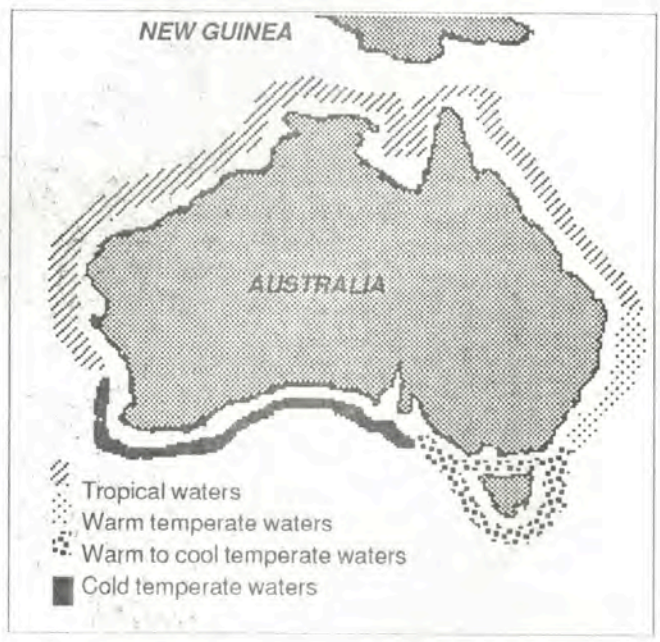


Fig 20: The marine regions of the Australian coast(after Maxwell)

We are looking at life in the tropical waters of the eastern Australian coast; a scene that is dominated by reef building organisms that florish in clear, rapidly circulating water where the average sea temperature of the coolest month is not lower than 22°C.

The tropical region where warm waters are suitable for reef formation extends from south of the Abrolhos Islands in Western Australia, to central New South Wales.

There are many types of corals, but they can be divided into two main groups: reef-building corals and corals that do not build reefs. Reef-building corals are found only in shallow, warm tropical waters. Some reefs get into the subtropics or even temperate areas but their diversity and extent are greatly reduced.

In eastern Australia, the southern extremity of any extensive reef formation is in the area of the Solitary Islands and adjacent coast near Coffs Harbour, N.S.W. Here there is a mixture of reef and non-reef species occurring together and the number of coral species is reduced. A few areas of small reefs or scattered coral colonies occur at various widely scattered localities even further south.

Because sunlight is essential for reef growth and because light has limited penetration into water, most coral grows in relatively shallow water. On the Great Barrier Reef, coral extends from or near the surface of the water down to about 50 metres though most of it is in the upper 30 meters.

Some species are characteristic of shallow water and others of the deeper regions. Near the upper and lower depth limits the number of species becomes considerably reduced.

The presence or absence of reefs is influenced by mainland rivers. Such rivers alter the salinity of water adjacent to the coast and may affect corals locally that way. Also of importance is the load of silt that rivers carry.

Corals are sensitive to particles that are found in the water. These particles reduces the water clarity and deposit silt on them.

Other requirements of a reef include sufficient oxygen for sustaining life, and carbonates from which to construct the coral skeleton. Supply of these carbonates depends in part on patterns of water circulation and aeration which is promoted by surf action.

The figure below shows the distribution of coral reefs worldwide. What is an isotherm and what isotherms do coral reefs grow between?

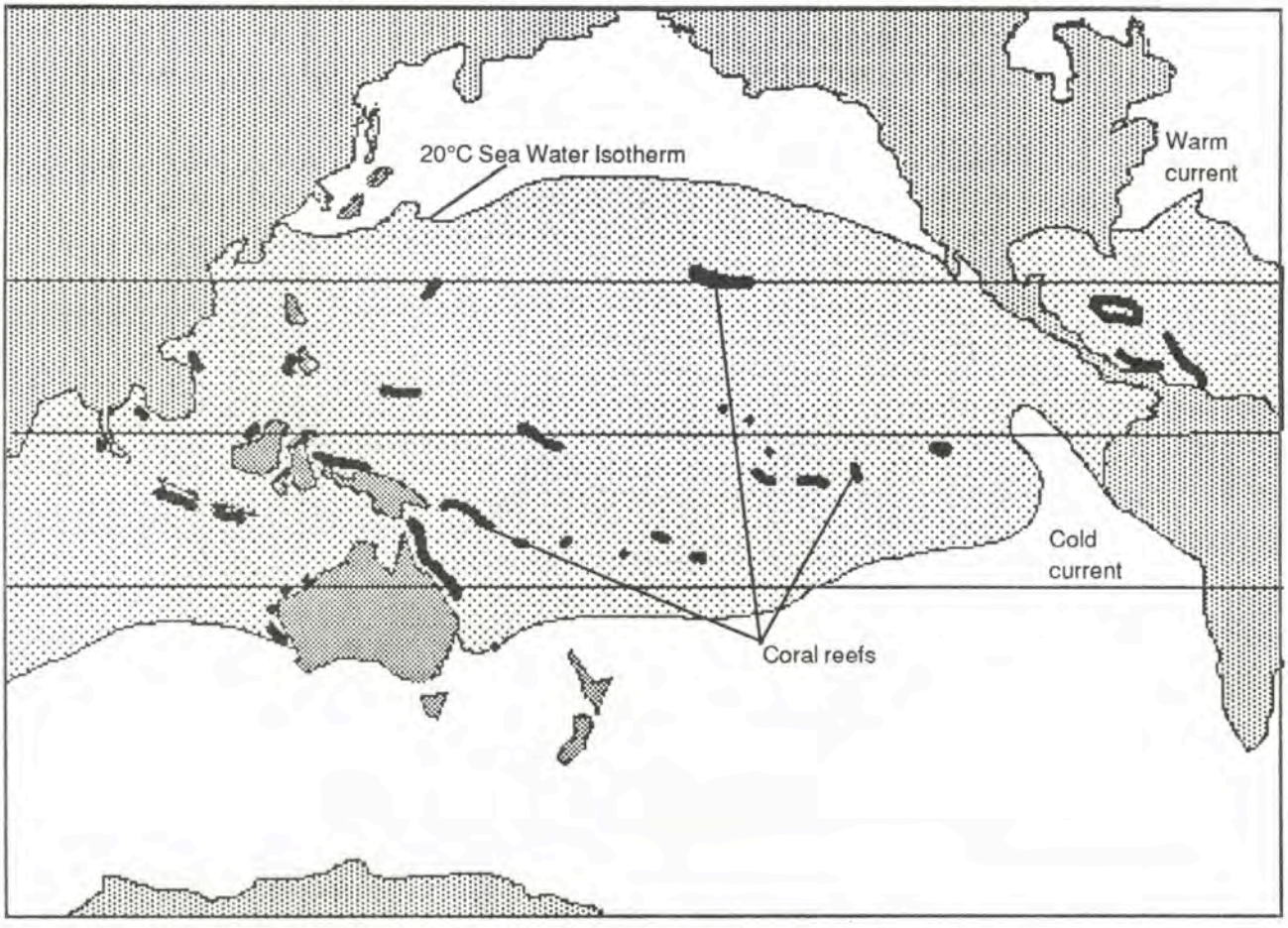


Fig 21: The coral reef regions of the world are found within distinct isotherms

CORAL REEFS

Coral reefs have been divided into two major categories.

The first comprise the oceanic reefs which are found in the open ocean, have a non-limestone reef base and occur in deep water (over 100 fathoms.)

The second includes the shelf reefs which occur in relatively shallow water on continental shelves.

Since the Great Barrier Reef occurs on the Queensland shelf we will examine shelf reefs first.

The separation of reefs into different types is based on shape, central structure (e.g. development of a lagoon), general zonation and their location on the continental shelf.

Generally speaking, the reefs of the Great Barrier Reef can be separated into three main types:

1. Linear reefs or wall reefs or ribbon reefs (commonly referred to as outer barrier reefs) occurring near the seaward margin of the shelf.

2. Platform reefs or patch reefs, which comprise the majority of reefs, have an oval shape and lie between the continental shelf and the mainland.

3. Fringing reefs that are found growing out from the shores of continental islands and the mainland.

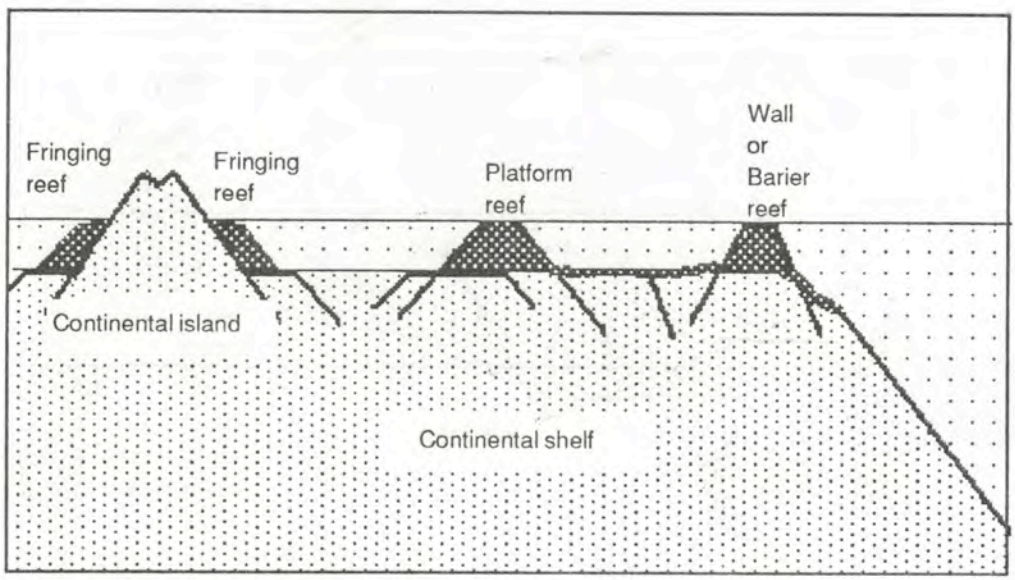


Fig 22: Diagramatic sketch showing the continental shelf and the three major types of reef found off Queensland's coast

Wall reefs

The simplest type, and the one which represents the earlier stage of development is the wall reef. It is an elongate reef with the long axis along the edge of the continental shelf or coast line.

The reef front and algal rim are on the seaward side, grading into reef flat and finally to the reef back on the leeward side. Water flowing through gaps between such reefs brings nutrients and promotes reef growth along the leeward borders of such passages. These reefs form a wall-like structure which takes the full battering force of big waves of the Pacific Ocean. They are common in the northern part of the Great Barrier Reef.

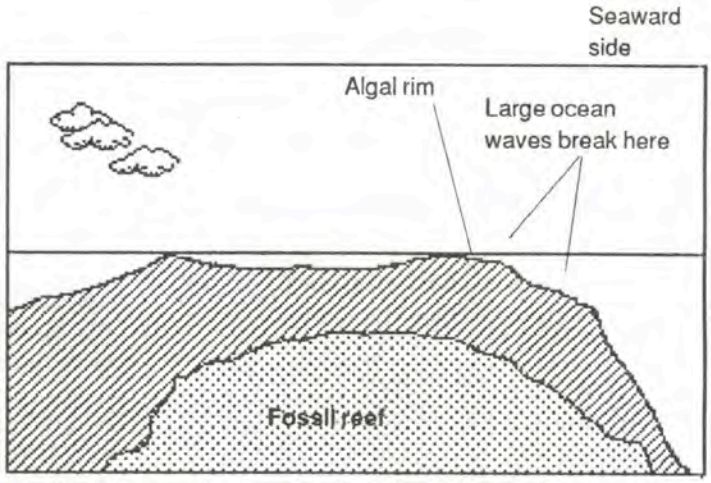


Fig 23: Diagramatic cross section of a wall reef. These types of reef are found on the outer barrier reef.

Platform reefs

These formed where there are open, shallow areas where wave action, tidal currents and water composition are equal on all sides of a reef. Growth can occur equally in almost any direction.

With continued enlargement, the central part of the reef becomes more sheltered from the surf and wave action which is essential for the aeration and nutrition of the corals and algae of the reef face and algal rim. Much coral dies and there is a general deterioration of the central area. The formation of a lagoon can occur with the subsequent growth of patch reefs composed of corals which can tolerate the quieter lagoonal conditions.

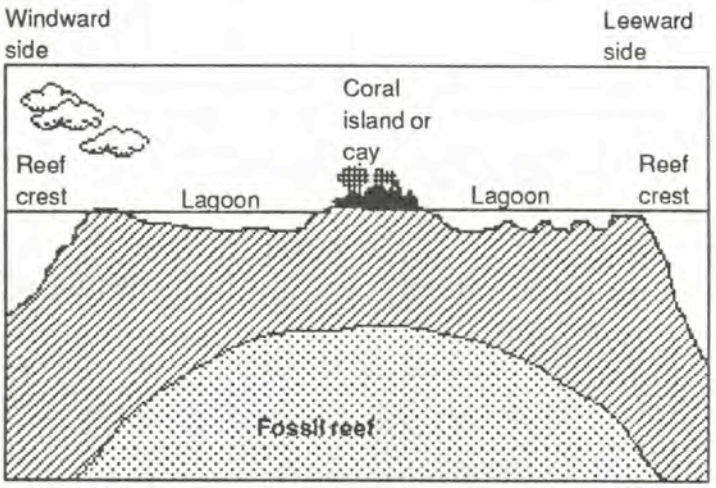


Fig 23: Diagramatic cross section of a platformreef. These types of reef are found in more sheltered areas

Many patch reefs have shallow water lagoons in the centre and some support coral islands. The formation of these coral islands or cays is discused later.

Fringing reefs

These can be found growing around continental islands or along mainland shores. A continental island is really an underwater mountain with its peak above the sea's surface. Corals and marine plants (algae) may settle and grow in the shallow waters round the peak, forming a fringing reef. Of the three main types of reef, the fringing reef is most susceptible to rainfall due to its close proximity to the continent.

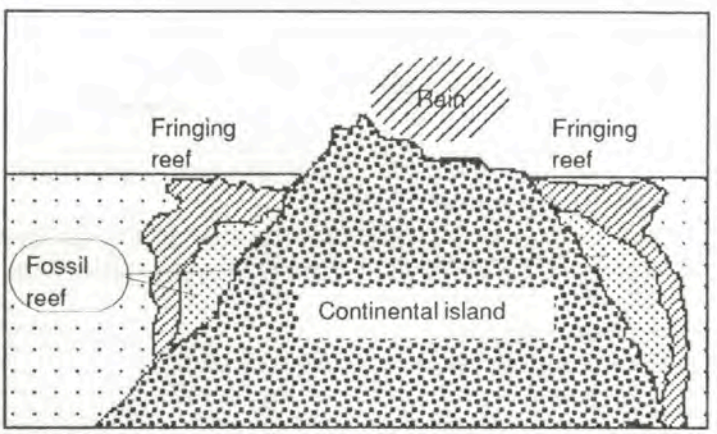


Fig 24: Diagramatic cross section of a fringing reef. These types of reef are found adjacent to continental islands.

Attols

An Atoll is a coral reef which belongs to the other category of coral reefs-the oceanic reefs.

Atolls are roughly circular in shape often projecting above the sea's surface. Commonly they consist of a ring of islands surrounding a shallow lagoon.

Chales Darwin proposed the first acceptable theory of how atolls were formed. He said they started when corals grew around the edge of an island, forming a fringing reef.

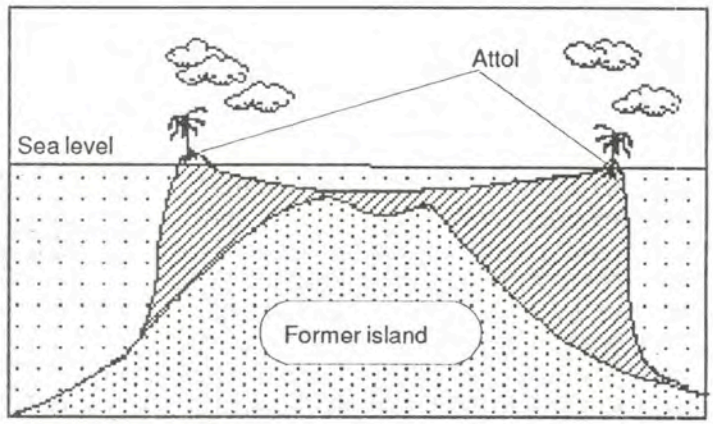


Fig 25: Diagramatic cross section of a attol. Attols belong to the second group of coral reefs called oceanic reefs.

Then the land began to sink slowly, but the corals, growing rapidly, were able to build up a coral platform and maintain themselves in near-optimum conditions near the surface. The land continued to submerge, the corals surviving but always doing best on the outer side. Overcrowding and lack of sufficient food and sunlight gradually retarded the growth of corals inside the ring.

Eventually only a small part of the island remained, surrounded by a lagoon and an offshore, or barrier reef. In time the land sank beneath the sea, leaving only the ring of coral an atoll. It has been suggested that all atolls were formed much in this matter, either by the sinking of the bottom or the rising of the sea level.

ASSIGNMENT 2 BUILD YOUR OWN CORAL CAY

Purpose

For you to build a model coral cay to understand its geological history and its structure

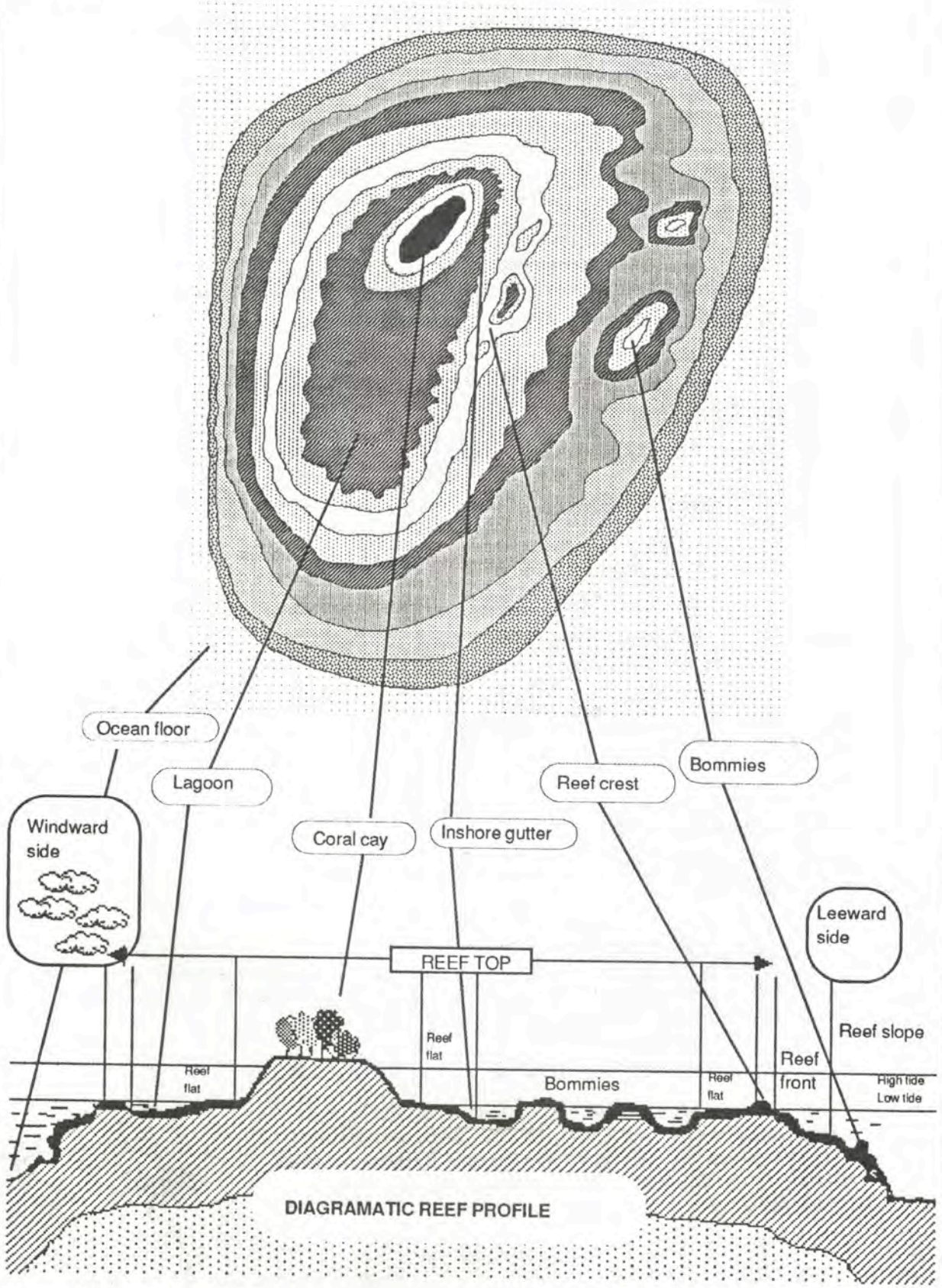
You will need

Hypothetical reef kit:
1 empty beer carton
1 plan of hypothetical bay (use the copyright free pages from the appendix)
1 stanley knife or sharp scissors
1 tin paint
1 bottle glue

What to do
1. Look carefully at the models presented for you on the next page.
2. Identify on the plan, from the cross section the following parts of the coral cay
   - (a) Ocean floor
   - (b) Windward side
   - (c) Leeward side
   - (d) Bommies
   - (e) Reef crest
   - (f) Algal rim
   - (g) Lagoon
   - (h) Inner coral zone
   - (i) Outer coral zone
   - (j) Inshore gutter
   - (k) Coral cay and beach
3. Now cut out your model, use the beer carton cardboard and glue to make a coral cay.
4. When you have finished, clearly label the model and keep it for Chapters 3 and 4.

Questions to answer
1. Where are the pools located in the crest?
2. Why is one side steeper than the other?
3. How many bommies are on this reef?
4. Where is the algal rim?

SCALE MODEL OF HYPOTHETICAL REEF (Use the copyright free pages in the appendix for the plan to make your model)



Assignment 2:

Due Date: Your teacher will set this for you but note it in your diary.

Criteria for marking:

Each class has their own ideas on standards, however the following should be discussed prior to or during the time used to construct the model. Some students may wish to construct or design their own models. This could be an alternative assignment. In this case you may wish to consider the following:

Make a model attol or a series of models showing attol formation.
Make a wall, platform or fringing reef. Cut one in half showing the fossil reefs.
Make a series of reefs showing the differences between the various shapes and write a series of hypothesis suggesting how each was formed.

Here are some suggested questions for you to discuss as a class.

1. Model construction:
   *have all the lines been cut out precisely?
   *have all the levels been made correctly?
   * have the following been clearly and accurately presented in the model?
      (a) pools in the crest
      (b) bommies on the leeward side
      (c) the slope on the windward side
      (d) the inshore gutter beside the coral cay
      (e) the coral cays position
      (f) the crest
      (g) the gutters on the seaward side
   * have the above been clearly painted, coloured or identified
   * has the model been thrown together at the last minute or is their evidence of painstaking meticulous work
   * does the model demonstrate pride in work
2. Have all the questions been answered correctly? Should a "high achiever" be able to write a good hypothesis and make predictions?
3. How many of the above standards should a "very high achiever" attain and are there any additional standards to be specified?

Questions to answer

Easy

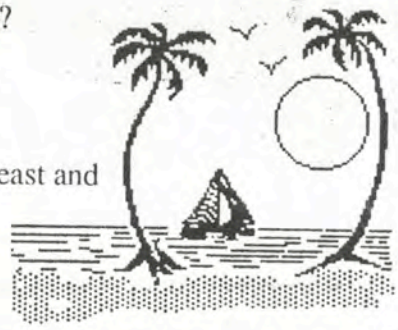
1. Is this model a wall, platform or fringing reef?
2. At what depth is the reef crest and what do you think it would look like?
3. Where are the pools located and how do you think they got there?
4. Where is low tide and high tide on the model? Why?
5. What will grow on the coral cay?

Medium

6. Where will sand accumulate in the model and why?
7. Where will sharks live and will they live there all the time?
8. Where is the windward side? Give reasons for your answer?
9. Where will the tallest trees grow on the coral cay. Why?
10. Could this be only a sand cay?

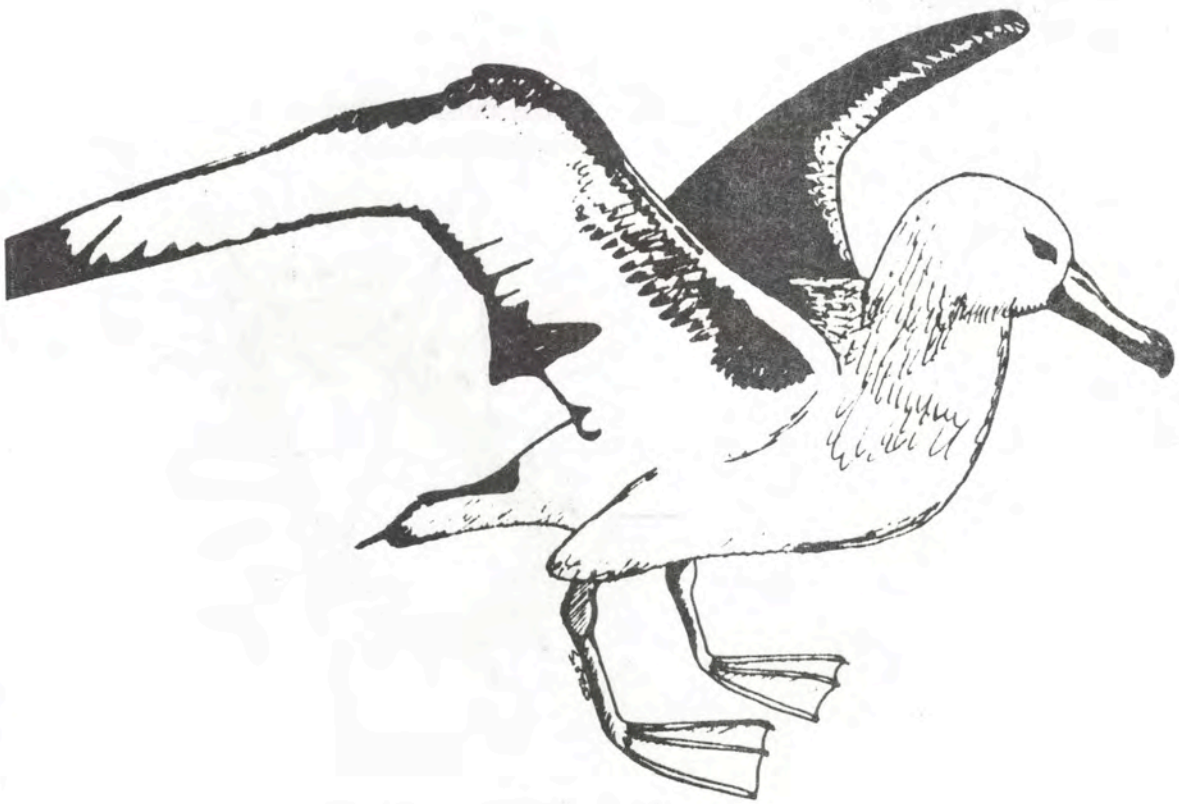
More challenging

11. If the prevailing winds are south east, which is north, south east and west on the model. Write a hypothesis predicting this.
12. What sort of evidence would you have to collect to support this hypothesis.
13. Use reference materials to describe how the cay became vegetated.



CHAPTER 3

CORAL CAYS



This chapter discusses the coral cay model you built in Assignment Two.

Coral cays are small islands formed of dead coral or coral shingle, either as a result of an old reef being elevated above the sea and then weathered, or from storms tossing coral rubble into a sand cay or reef flat.

From the air, coral cays can be seen forming at one end of reefs. Also, if you have studied another unit in this series called *Coastal Physics,* you will remember that waves as they pass around a reef bend. This process is called *refraction.*

A coral reef is living, growing and constantly changing. Waves, especially storm waves, are continually breaking up both living and dead coral and other limestone secreting organisms. Also, thousands of parrot fish are constantly chewing at the coral and breaking it down.

The rubble produced in this way is constantly being ground up and shifted by waves, tides and winds. Over a long period of time this coral rubble can be transported around the cay in the direction of the longshore drift and thrown up as sand by the wind, waves and currents onto the reef top on the sheltered or lee side.

When the rubble and sand are washed together in one spot they form a sand spit which may eventually develop into a true coral island called a cay.

Sand cays are small islands composed of sand which has been deposited by the slowing down of converging currents,and shaped by the action of wind, waves and currents.

Sand cays are often tempory, especially very small ones which appear and disappear, and when present, constantly change size and shape.

Heron Island, North West Island and Green Island see Fig 19, are examples of the many sand cays that are found off Queensland's coast.

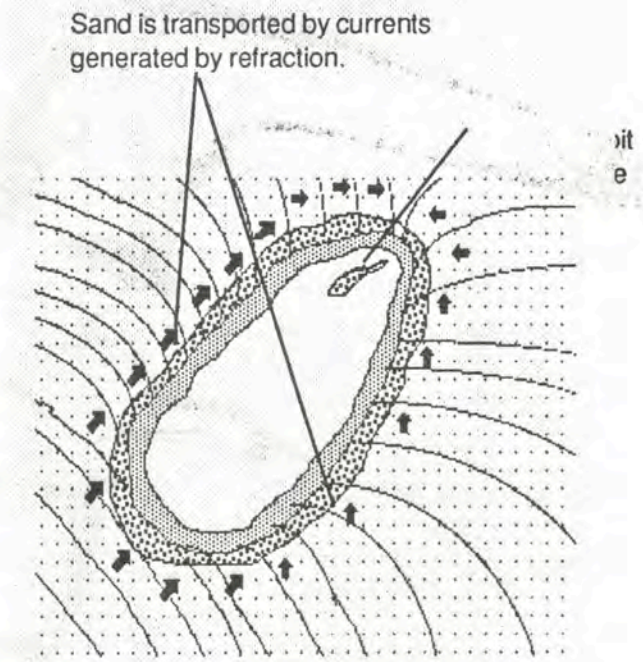


Fig 26: Refraction around a cay causes sand to be transported to one point and dumped

THE STAGES OF CORAL CAY DEVELOPMENT

As can be seen from Figure 26, sand can accumulate at the end of a reef to become a sand spit.

These sand spits come and go with time, but if conditions are right can increase in size.

Fig 27 shows a sand spit developing at the end of a coral reef.

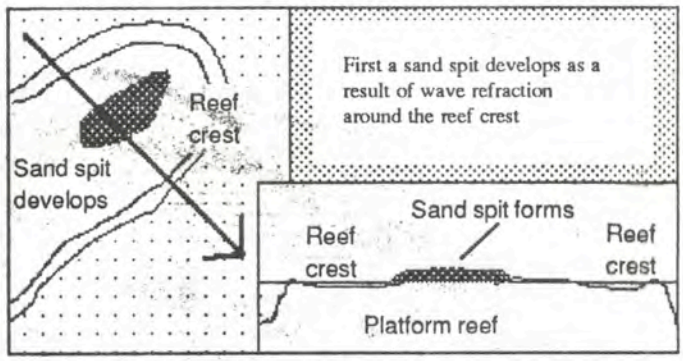


Fig 27: Stage 1. A sand spit forms at the end of the reef

As a cay increases in size the first visitors are sea birds. With time, their droppings form a layer of organic humus, called guano.

In this way the small cay is made suitable for the growth of any salt resistant plant seeds that drift, or are carried by winds and birds to the island. Other seeds may be deposited in the droppings of birds that rest there. The bird droppings also provide fertilizer for plant growth.

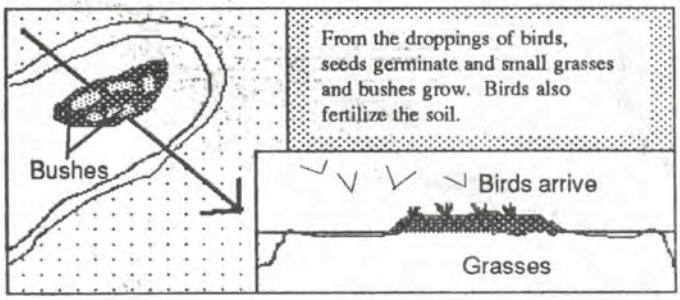


Fig 28: Small plants grow out of seeds dropped by birds, birds droppings also fertilize the sand

Figure 29 shows that with this increased fertilizer, the plants grow covering nearly all of the cay. Eventually, dense vegetation will probably cover the cay. This can be up to 5 or 6 metres high and very thick in places. Weeds, cock-roaches, lizards, creepers and moths are some of the other organisms that can live in this dense growth.

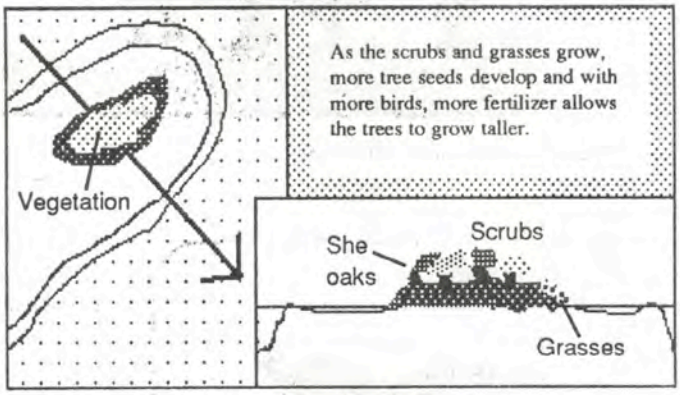


Fig 29:Stage 3. Vegitation almost complete

Vegetated cays, Fig 30, provide ideal places for many sea birds and turtles to nest and lay their eggs. If allowed to develop over a period of time this process can build up quite a complex community of plants and animals on the small cay.

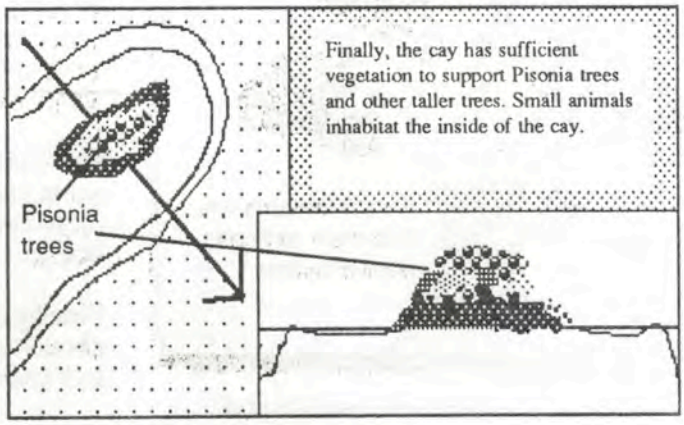


Fig 30: Stage 4. Fully vegetated cay

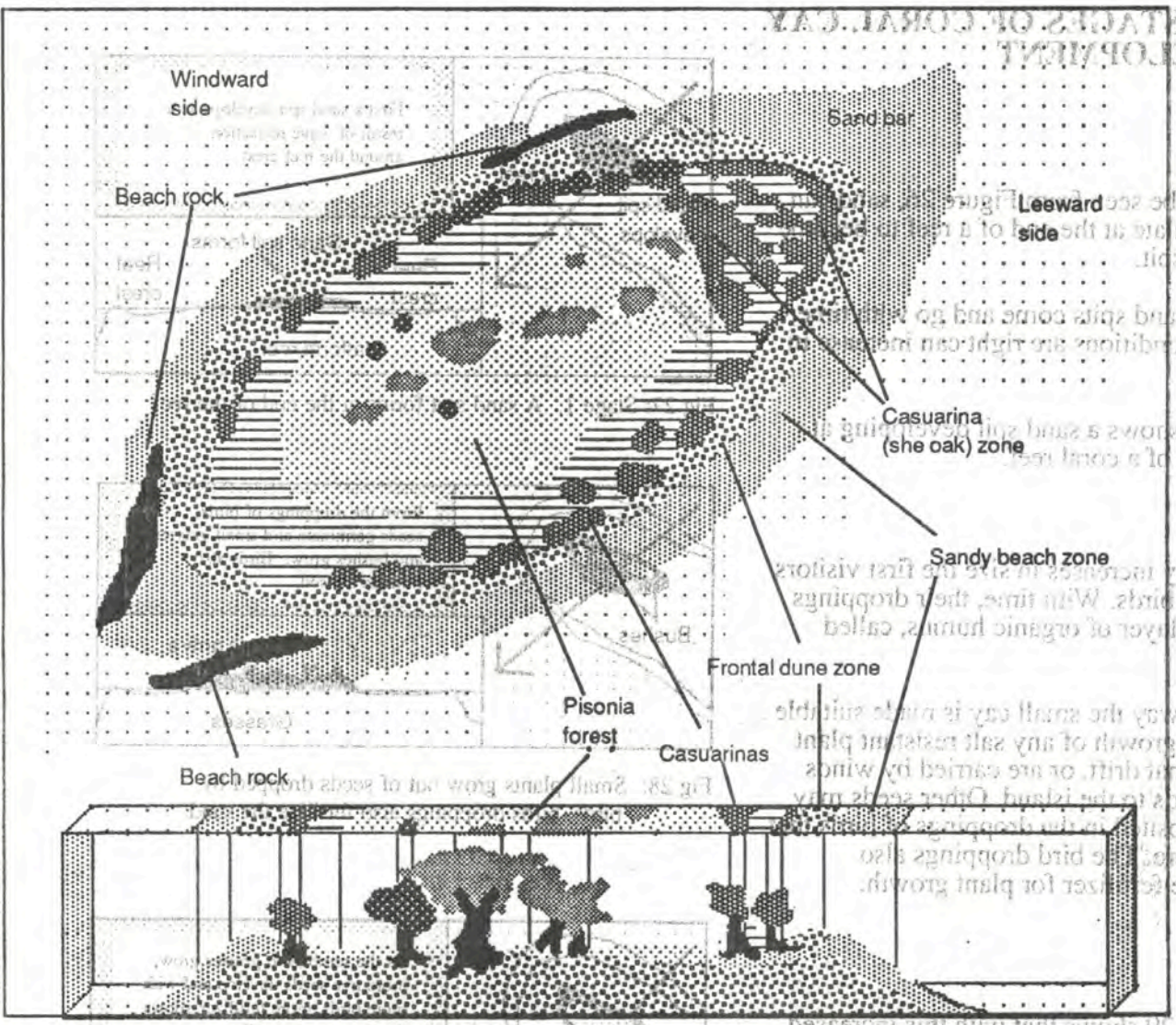


Fig 31: Vegetation patterns on a coral cay

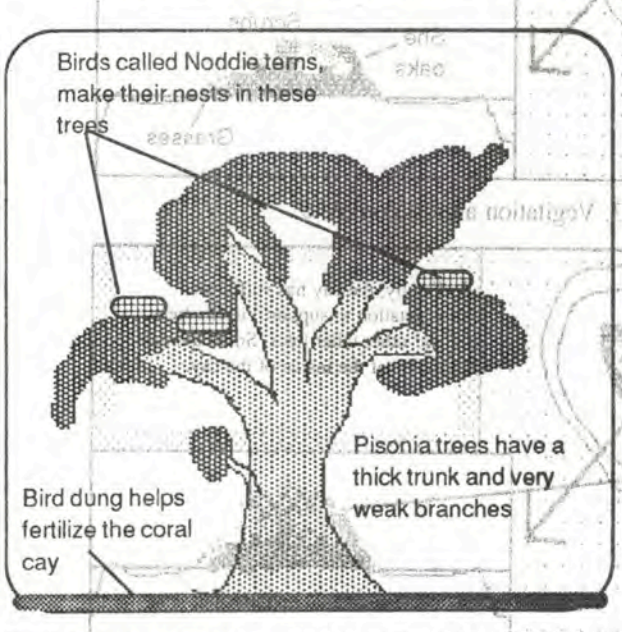


Fig 32: Pisonia tree, common to the central part of coral cays.

Cays often have only a few species; these are usually ones that are tolerant of beach or sand conditions (salt tolerant, resistant to dessication and are especially adapted to dispersal over water).

There is a series of types of cays in terms of their vegetation and permanence, ranging from bare ones to those that are forested. Very small or temporary cays may be completely devoid of vegetation, others have only beach vegetation.

On still others there is in addition a herb flat, in some cases accompanied by a shrub ring. On more stable cays, forests or groves of trees occur.

Finally on the more complex ones, all of the above types vegetation may be seen as shown in Figure 31.

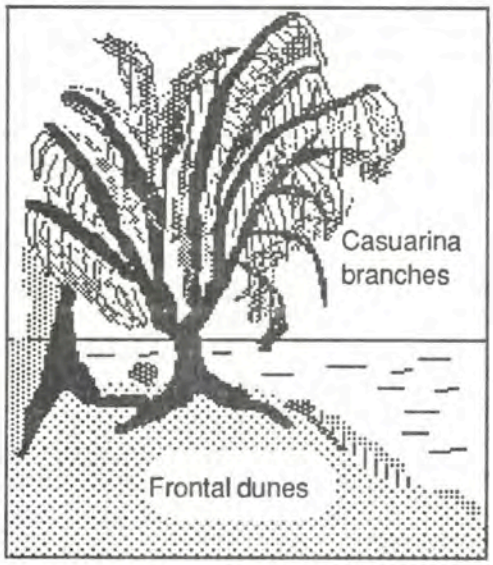


Fig 33: Casuarina, or She Oak, found on the frontal dunes. The leaves of the Casuarina are really not leaves at all. They are the branches and at the very tip of these branches are found the 6-7 leaves in what scientists call a "catkin".

Pisonia trees provide homes for many species of sea bird. The bird dung accumulates at the base of the tree, and dissolves when it rains to provide a fertilizer for the tree to grow in.

The Pisonia tree, has very big leaves which are easily blown off. These fall to the ground and make instant cover for the many small insects that live on the cay. In some cays, large cockroaches make exclusive use of this small habitat called a *microhabitat*.

By contrast another tree, the Casuarina, is found close to the beach on or just behind the frontal dune system. This tree helps the vegetation on the cay by cleaning the air of salt before it blows into the Pisonia forest.

As the salt air blows at the Casuarina, the salt accumumlates on the branches. Therefore the air that blows into the Pisonia forest is less salty and less able to burn and dry out the leaves of the Pisonia tree.

The Casuarina has a second function. Its roots penitrate deep into the frontal dune. Out from each root is a root hair system which further helps to anchor the tree and bind together the sand.

When big storms such as cyclones strike the island, large waves break on the beaches causing beach erosion. The roots of the casurina help to hold the soil together. The branches also provide roosts for the many sea birds that come to the cay to live.

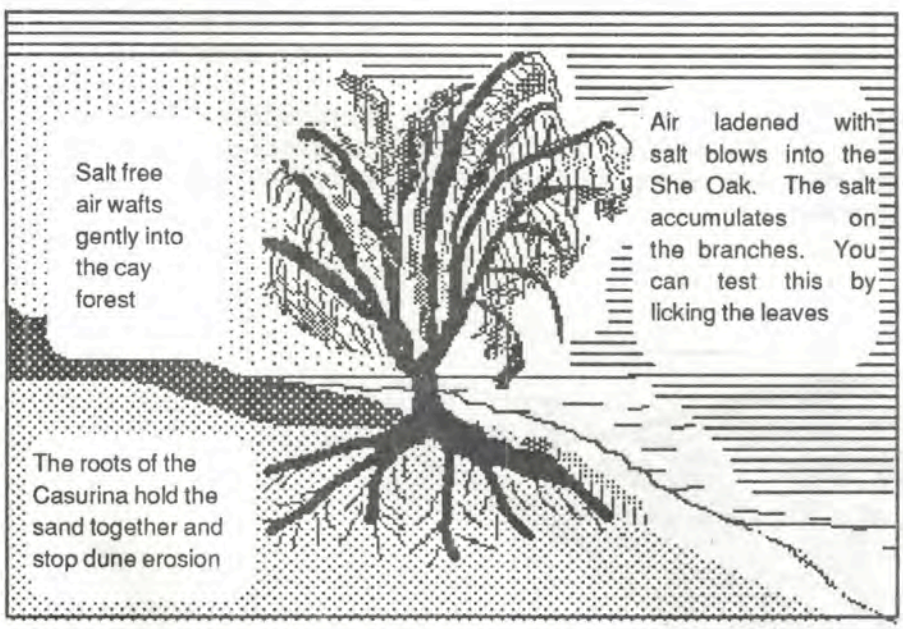


Fig 34: The two important roles of the Casuarina tree

Bird life

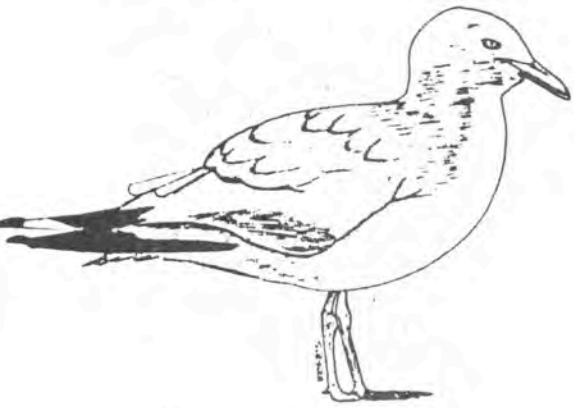


Fig 35: Sea gull

The Barrier Reef is famous for the bird rookeries that have been established over thousands of years. Many birds that visit the islands of the Barrier reef are migratory and have flown a long way to breed or stop over for resting. This is why you should never chase birds that are resting on the waters edge on coral cays.

If you visit a Barrier Reef island or coral cay it is important to look after the birds that you see. Humans can learn a lot about how their behaviour can interfere with a natural habitat and this section describes some of our insignificant habits that can seriously effect bird populations. The common sea gull is a good example.

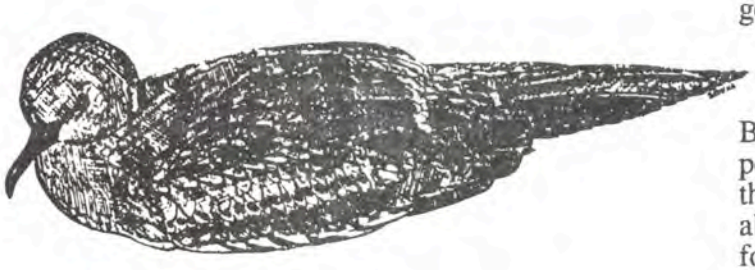


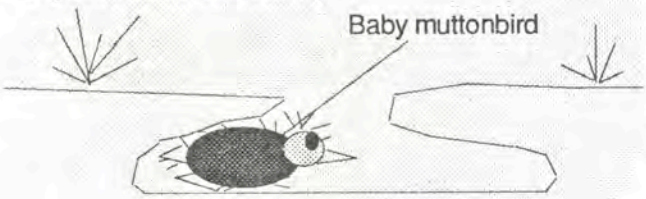
Fig 36: Mutton bird

Before Australia was colonised by white people, the sea gull population was small. As the white people created more garbage than the aborigines, the sea gull had more available food. Numbers increased and now the seagull is in much larger numbers than before.

A similar series of events has occurred on the barrier reef islands but the effect is more pronounced. The cays are smaller and fewer in number. Competition for space and food on the cays is greater and so an increase in gull population causes problems because:-

(a) they compete for more available space and food
(b) they eat baby turtles as they hatch and
(c) they prey upon the eggs of the noddy terns and mutton birds that inhabit the islands

Fig 37: Mutton bird burrow



Humans presence increases the problem. As helicopters or planes land on these islands, the noddy terns leave their nests and fly up into the air. This also happens when hoards of visitors play loud music, run generators, operate speed boats at excessive speeds or generally move about the island.

The birds fly up and the gulls eat the chicks. Sometimes once a bird is forced to leave its nest it may not return, leaving the chicks to die. Some birds, like the mutton bird, live on the ground in burrows. Here they reproduce and raise their young. Humans walking around can collapse these burrows, killing the chicks in the process.

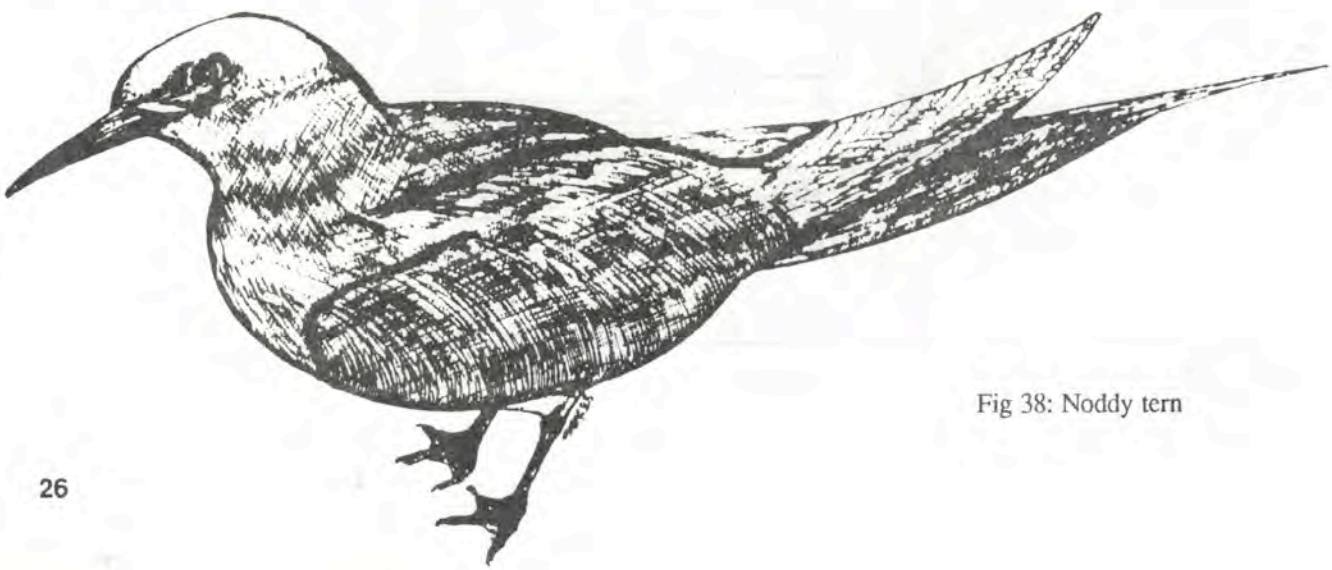


Fig 38: Noddy tern

ASSIGNMENT 3

DISCUSSION QUESTIONS/SHORT TALK

Purpose

To have each member in the class research a question about a coral cay and give a short talk on the topic.

You will need

*Reference books, Great Barrier Reef Authority Pamphlets, National Parks Pamphlets, **OR** Tourist Maps.*

What to do

Form a group of *five,* and discuss the following questions. You may have to use reference books from the library to answer some of them.

Then decide who will give a talk on which question. Each group has a theme. The first person introduces the theme and then the other members of the group expand on the theme. You must use the model you made in Chapter 2 to illustrate you answers.

At the conclusion of the talk each member of the group must hand in ***all*** the answers to the group's questions (in your own handwriting).

Group 1 How cays and islands form

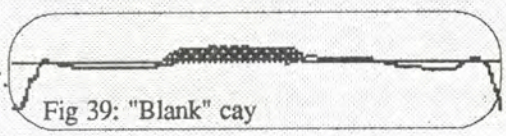


Fig 39: "Blank" cay

Q1. Here is a diagram of a cross section of a coral cay. Make a list of the things that would need to happen in order for it to become a fully vegetated coral cay.

Q2. What is meant by refraction and how does it contribute to the formation of a coral cay.

Q3. What is the reef crest and what forces break it down. You must mention Biotic and Abiotic factors. (You will also have to define Biotic and Abiotic)

Q4. How are fringing reefs formed? How does their crossection compare with a coral cay? Make a drawing or an overhead transparency to illustrate your answer.

Q5. In Northern Queensland, mangrove cays occur. Use the Great Barrier Reef Pamphlet on Coral Cays to explain the difference between the coral cay and the mangrove cay.

Group 2: Cay vegetation

Q6. Use a reference book to find a photograph of two coral cays. Prepare a vegetation map for each from it (like the one in Figure 31) naming the zones you can see.

Q7. From the vegetation maps prepared in Q6, make a cross-sections like the diagram in Figure 31, showing the distribution of the vegetation.

Q8. Take another island from one in Q6 and prepare a vegetation map naming the zones.

Q9. Prepare a crossection of the cay your friend is describing in Question 8.

Q10. Prepare a vegetation map from a photograph of a continental island.What type of vegetation is found there and how is it different from a coral cay

Group 3: Cay Plants

Q11. Find a photograph of a Pisonia tree. How big does it grow. How big are the leaves and give two reasons why it is important to cay life.
Q12. Find a photograph of a Fig tree. How big does it grow. How big are the leaves and give two reasons why it is important to cay life.
Q13. Here is an illustration of a mangrove. Find out where mangroves occur in coral cays. In what parts of Queensland are they found and how important are they to the coral cay?
Q14. Find a photograph of an Argusia and make an outline sketch of it. Where is it found on the cay?
Q15. Find a photograph of a Pandanas or Screw palm. Make a drawing of it and find out where it lives.

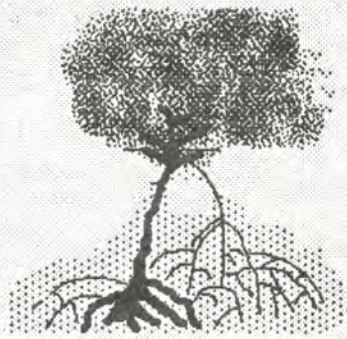


Fig 40: A Mangrove

GROUP 4: CAY BIRD LIFE

Q16. Find a photograph of a Noddy tern and make a colour drawing of it. Where does it build its nests and why? What food does it eat and when doe it return back to the nest to feed its young?
Q17. Find a photograph of a reef heron. Where does it build its nest and what does it eat. Make a colour drawing of it.
Q18. Find a photograph of a sea gull. What happens to the colours of their legs as they get older? What do they eat and why are they a nuisance to other birds on the reef.
Q19. Find a photograph of another bird. Make a colour drawing of it and list two interesting points about its behaviour.
Q20. Find out which bird the person is answering in question 19. Select another bird and make a colour drawing. List any three things that you find interesting about this birds life style.

GROUP 5: CAY INVERTEBRATE LIFE

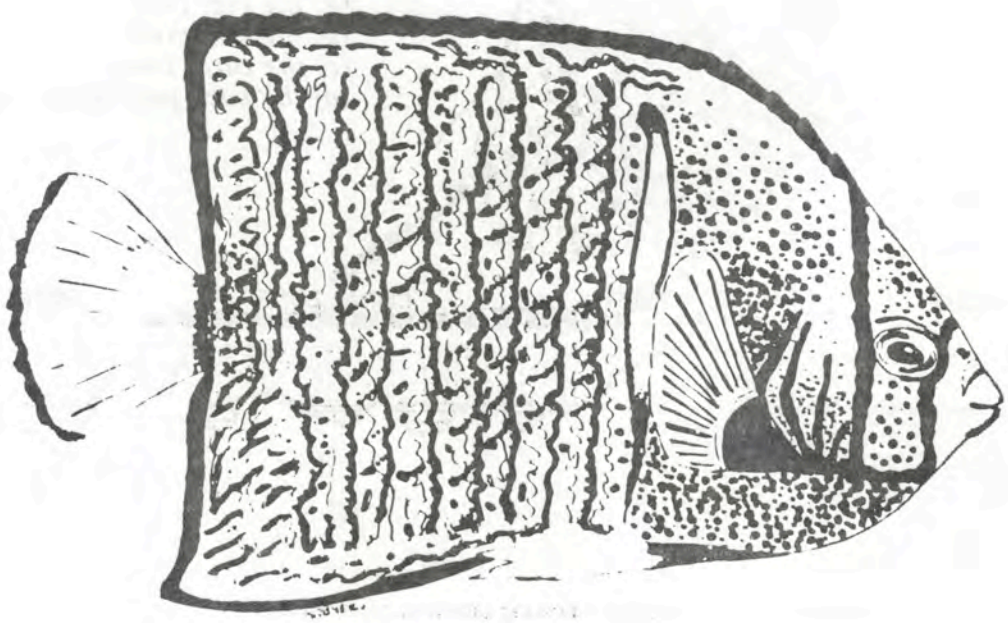
Q21. Use the index of a book to make a list of the invertebrates that are found on a coral cay.
Q22. Where are spiders found on coral cays? What are their predators and their prey?
Q23. Are ants found on coral cays? How did they get there and what effects do they have?
Q24. Are bacteria found in the air around a cay? What effects would a virus have on Pisonia trees? How could the virus be introduced to an island where campers wanted to burn wood?
Q25. Do kangaroos, wallabies or other marsupials live on cays? Give reasons for your answer.

GROUP 6: HUMAN INFLUENCES ON THE CAY

Q26. Make a list of the types of resorts that are found on coral cays. Who goes there and why?
Q27. Make a list of the effects humans would have on a cay where there was a tourist resort.
Q28. Make a list of the effects humans would have if camping on a deserted cay.
Q29. Talk to the persons who are researching questions 27 and 28 and say which humans have the greatest effect.
Q30. What effects do helicopters have on the bird life on cays? Use the model you made in Chapter 2 to explain where you would land a helicopter on a coral cay and why.

CHAPTER 4

CORAL REEFS



There are three main types of reef:

Wall reefs, which occur on the outer barrier of the continental shelf, *Platform reefs*, which occur inside the outer reefs and *Fringing reefs* occuring around mainland islands.

All of these reefs have similar organisms that live in them, however, initially, it is worthwhile to consider each separately, to show the major differences between them. Coral attols are not discussed.

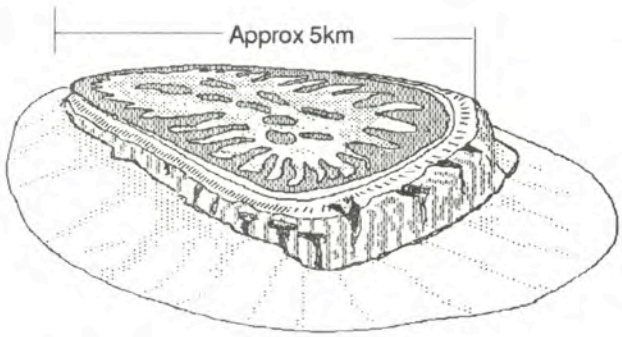


Fig 41: Three dimensional view of wall reef

WALL REEFS

A wall reef has no island and faces the Pacific Ocean. It has many of the features that other reefs have and is discussed first.

At high tide the reef is covered and at low tide it is exposed.

If a cross-section of reef is taken as is shown in Figure 42, some of the major characteristics of the reef can be discussed.

In this chapter, many cross-sectional drawings are shown and it is important to get a clear three dimentional view before further discussion.

Each of these four zones has a number of distinct characteristics.

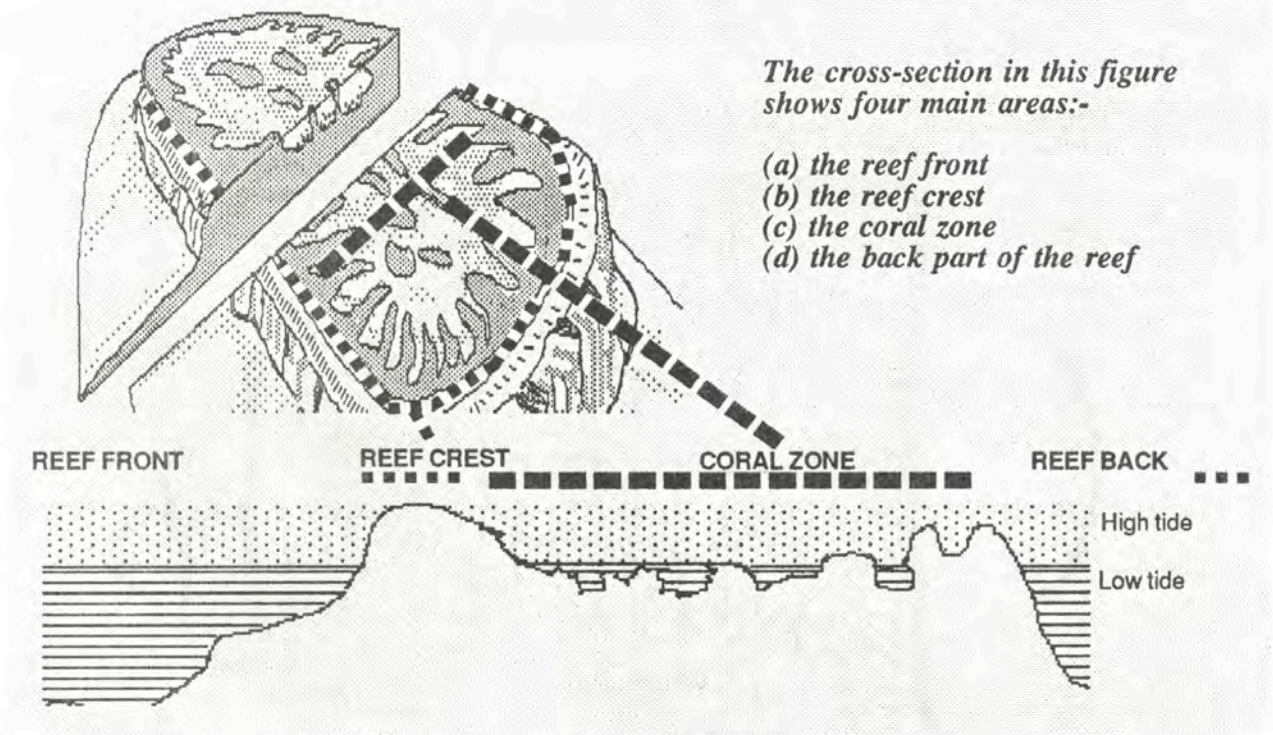


Fig 42: Three dimentional model of a wall reef showing cross-sectional zones

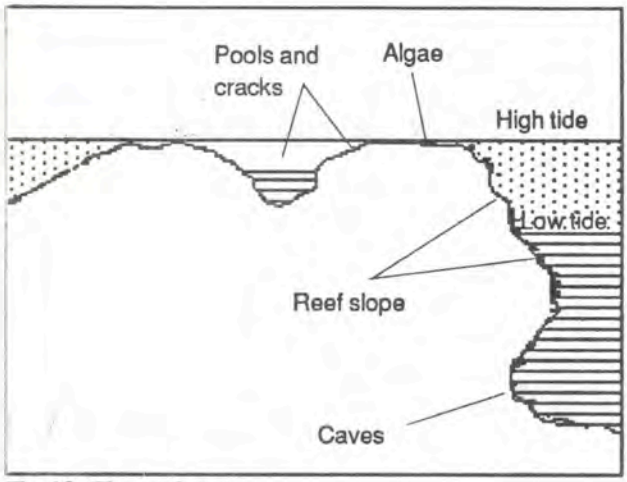


Fig 43: The reef crest

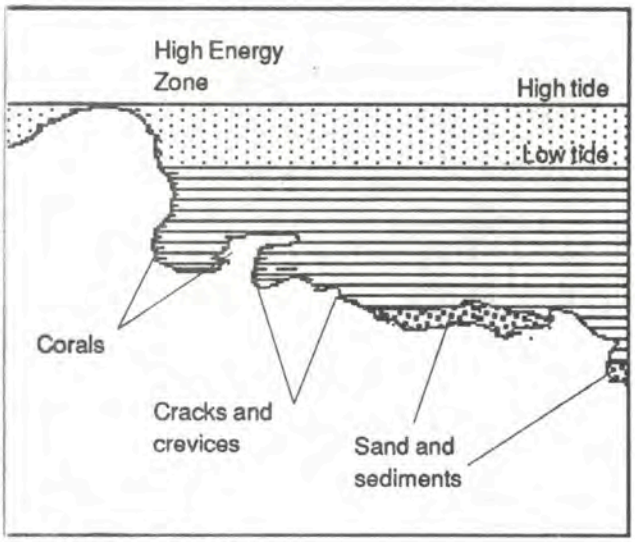


Fig 44: The reef front

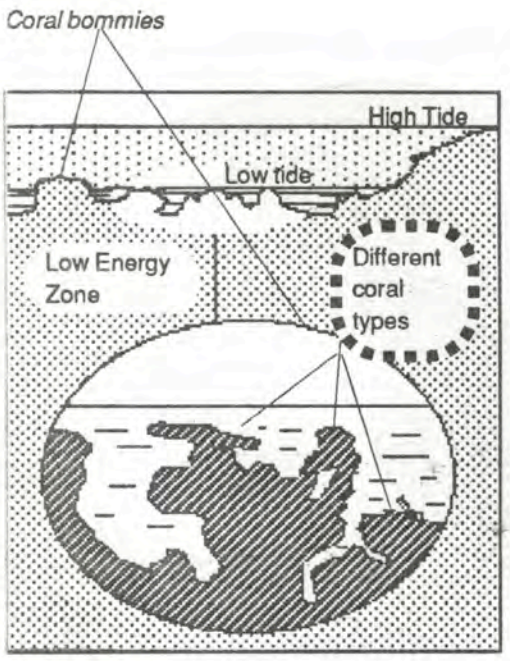


Fig: 45: The coral zone

The Reef Crest (Figure 43)

This is subjected to the large waves of the Pacific which break on the reef crest. It is often called a *high energy zone* because of the enormous forces that are subjected to it. These waves break at high tide.

At low tide the crest is laid bare and subject to the heat of the tropical sun. Some parts of the crest have cracks, other parts have small pools which can be left filled with water between the tides.

It is a harsh environment and very little animal or plant life can survive these rugged conditions.

The Reef Front (Figure 44)

Below the reef crest is the reef front, an area of coral outgrowth that is subjected to large swells and ocean currents. This front merges with the continental shelf and is subjected to upwellings from the deep ocean floor. These upwellings can bring with them an ever abundant supply of food and nutrients.

The reef front abounds with life. There are many hiding places for animals and caves, crevices and large coral outgrowths can be found at greater depths.

The Coral Zone (Figure 45)

This area is directly behind the reef crest away from the high energy crest zone. As the tide falls, water is trapped in the centre of the reef and provides a warm environment for coral growth.

The coral only grows to the height of low tide as the delicate coral polyps cannot grow well in the dry air. The coral zone is subject to currents, waves and pieces of coral that move around between the tides and in storms. These large waves break off coral that has grown and create a meandering effect that can be clearly seen in photographs of reefs.

A closer examination of this area reveals a wonderland of coral outgrowths. Many different species of coral can grow here in a variety of shapes.

These different shaped growths provide many habitats for individual organisms to live.

A habitat is an organisms living place.

CHAPTER 4

PLATFORM REEFS

Platform reefs are located some distance towards the mainland, away from the forces generated by the waves of the Pacific. Usually they have a different shape, due in part to, the direction of the prevailing winds.

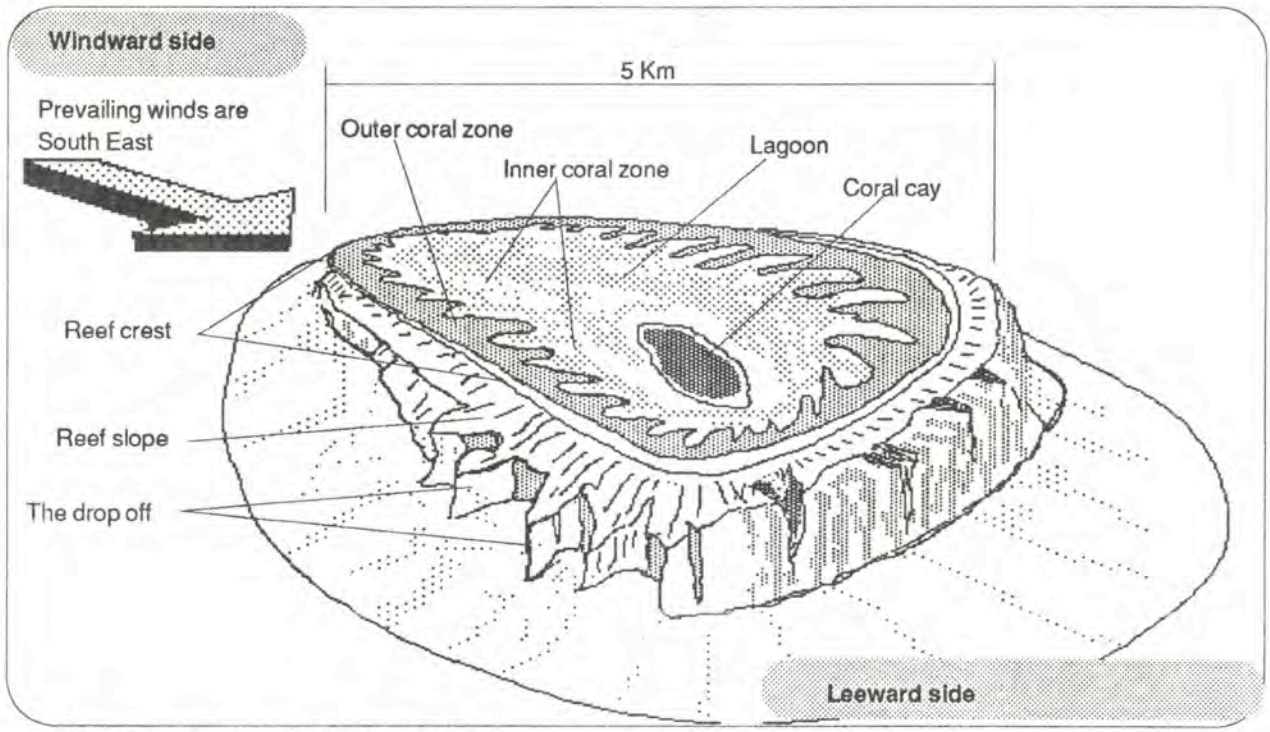


Fig 46: Three dimensional Platform Reef

In the *Booklet Coastal Physics*, you found that wind is largely responsible for waves and in the last chapter, you discovered that coral cays were formed as a result of sand particles being swept around the crest and dumpted at one point.

These facts are relevant when considering platform reefs, some of which have islands.

Figure 46 shows a platform reef with a coral cay.

Figure 47 shows that reef and cay viewed from the air and Figure 48, a crossectional view.

Class activity

See if you can find the photo in a refernce book to match Figure 47. What is the name of the coral cay you have found?

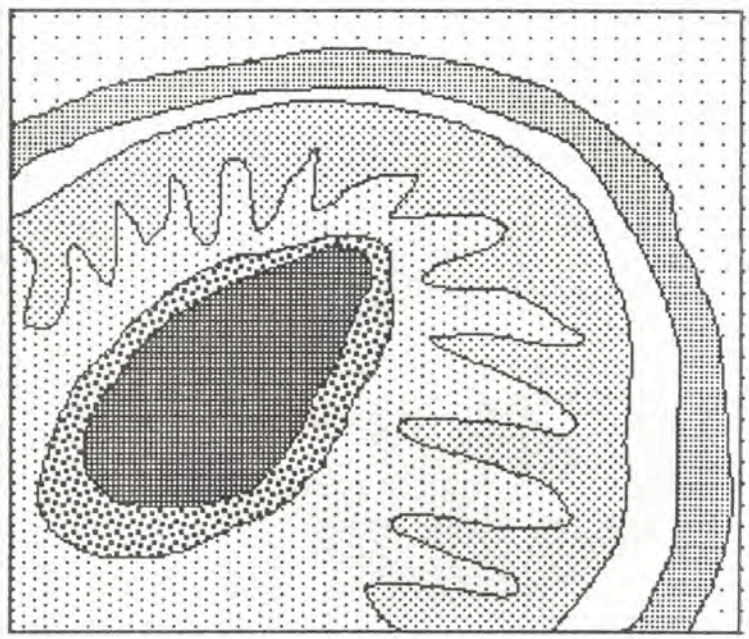


Fig 47: Aerial view of coral cay

Differences

The reef is different from a wall reef in that

(a) on the surface both sides are relatively even in shape
(b) there are two coral zones behind the reef crest
(c) there is a windward and a leeward side causing different shapes in the reef slope
(d) platform reefs are usually larger because they have grown up behind the wall reefs.
(e) they usually have a hollowed out section in the middle called a lagoon. The coral usually dies in this lagoon and fills with sand.

The Two Sides

The windward side faces wind generated currents and has the advantage of receiving nutrients first. The leeward side has the advantage in being a low energy zone and allows for larger coral outgrowths.

Similarities

The crest, although not subject to such large forces as in wall reefs, still is laid bare at low tide and still is subject to storm waves.

The coral zones of wall reefs bear some similarities to the outer coral zone of the platform reefs.

This area is a relatively low energy zone, forms pools at low tide and is covered again at high tide. Many of the animals and plants that are found on wall reefs are also found on platform reefs.

Examples of platform reefs with coral cays are Heron Island, Green Island and Lady Elliot Island.

Class Activity

Find a Photograph of a Coral Cay and a Wall reef (sometimes called a fringing reef) and identify the differences just mentioned. Write to or ring a travel company and request travel brochures on Heron, Lady Musgrave, Lady Elliott and Green Islands.

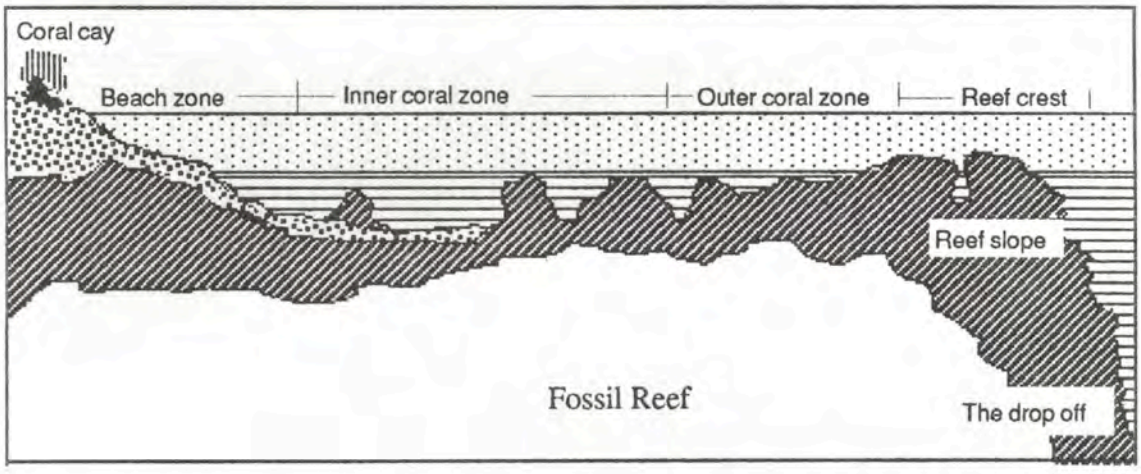


Fig 48: Cross-sectional view of coral cay

FRINGING REEFS ON CONTINENTAL ISLANDS

There are many islands on the Great Barrier Reef. These are of several kinds. Continental islands are those composed of rock and which at one time were connected to the mainland but have since become separated . See figures 22 and 24, pages 16 and 17. These islands are the remains of hill tops of the old land surface that was flooded when the Great Barrier Reef formed.

Most of the large islands close inshore are this type,e.g. Hinchinbrook Island, Lizard Island and the Cumberland Islands.

Volcanic islands, or those arising directly from the sea as a result of volcanic action and which have never been connected to the mainland, are not common on the Great Barrier Reef,although Murray Island in the Torres Strait is an old volcanic crater.

The flora and fauna on continental islands are not so different from those on the mainland as the rocks and the soil are the same type in both places, and continental islands are often large and near the mainland.

Continental islands may have similar vegetation as cays, especially on the beaches, but because of their large size,(usually) greater elevation and proximity to the mainland, they frequently have mainland species growing on them.

The particular species involved depends on the type of substrate, the latitude, and the vegetation of the adjacent mainland. Also, some of the species may have been retained from the time the island and the mainland were connected.

Class Activity

Find a photograph of a continental island and identify the zones mentioned in Figure 49.

Write to a travel company and ask for brochures on Lizard Island, Hamilton Island, Great Keppel Island or any of the islands in the Whitsunday group.

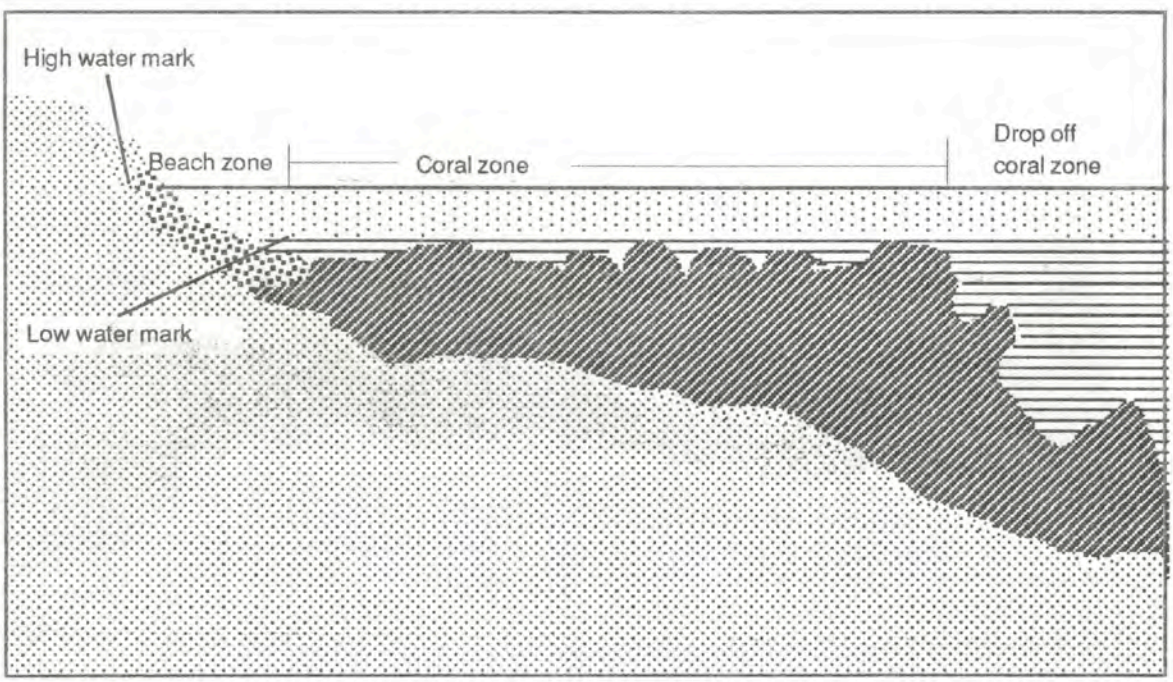


Fig 49: Cross-sectional view of fringing reef adjacent to a continental island

NORTHERN FRINGING REEFS

Some fringing reefs have mangroves. The diagram below shows one such group of islands, the Low isles.

Here mangroves grow along with living corals. Many of the Northern Islands have mangroves in zones such as shown in the figure below.

Because these islands are so inaccessablenot many people are aware that mangroves can be associeted with coral reefs.

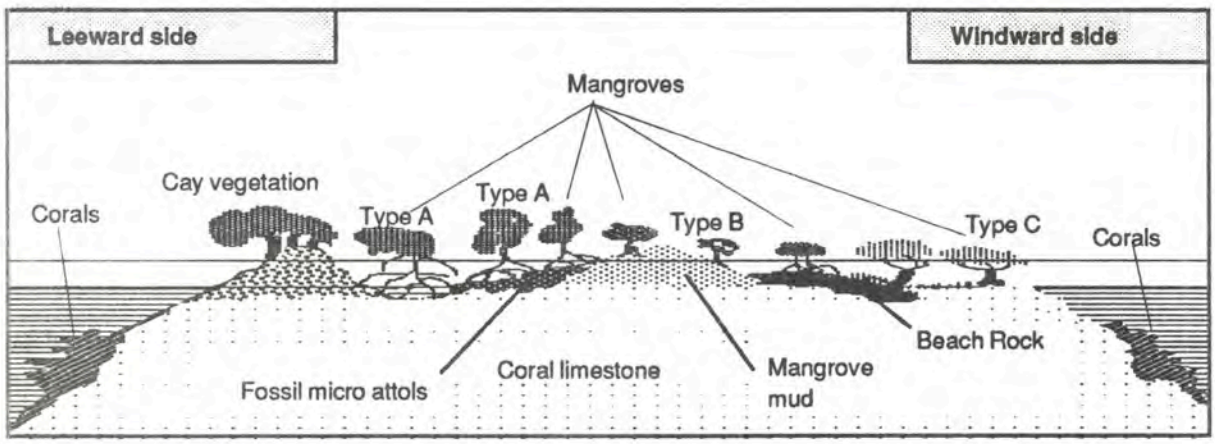


Fig 50: Crossectional view of a reef with mangroves (after Mead and Beckett 1984

Class Activity

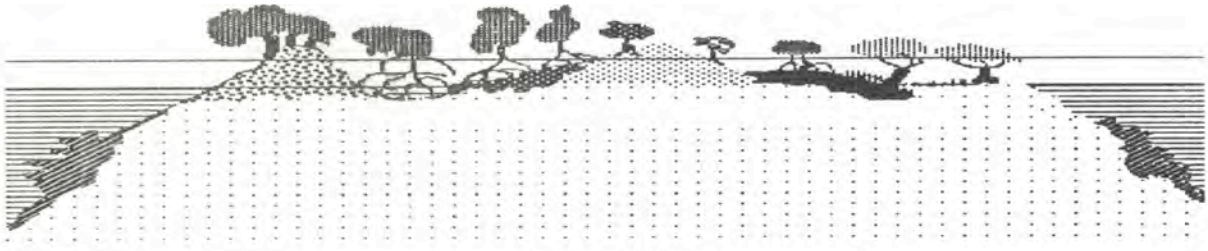
Obtain a copy of a book with the Low Isles mentined in the index. The Readers Digest Great Barrier Reef Book has one on page 321 and 323.

Now identify the zones mentioned in Figure 49.

REVIEW QUESTIONS

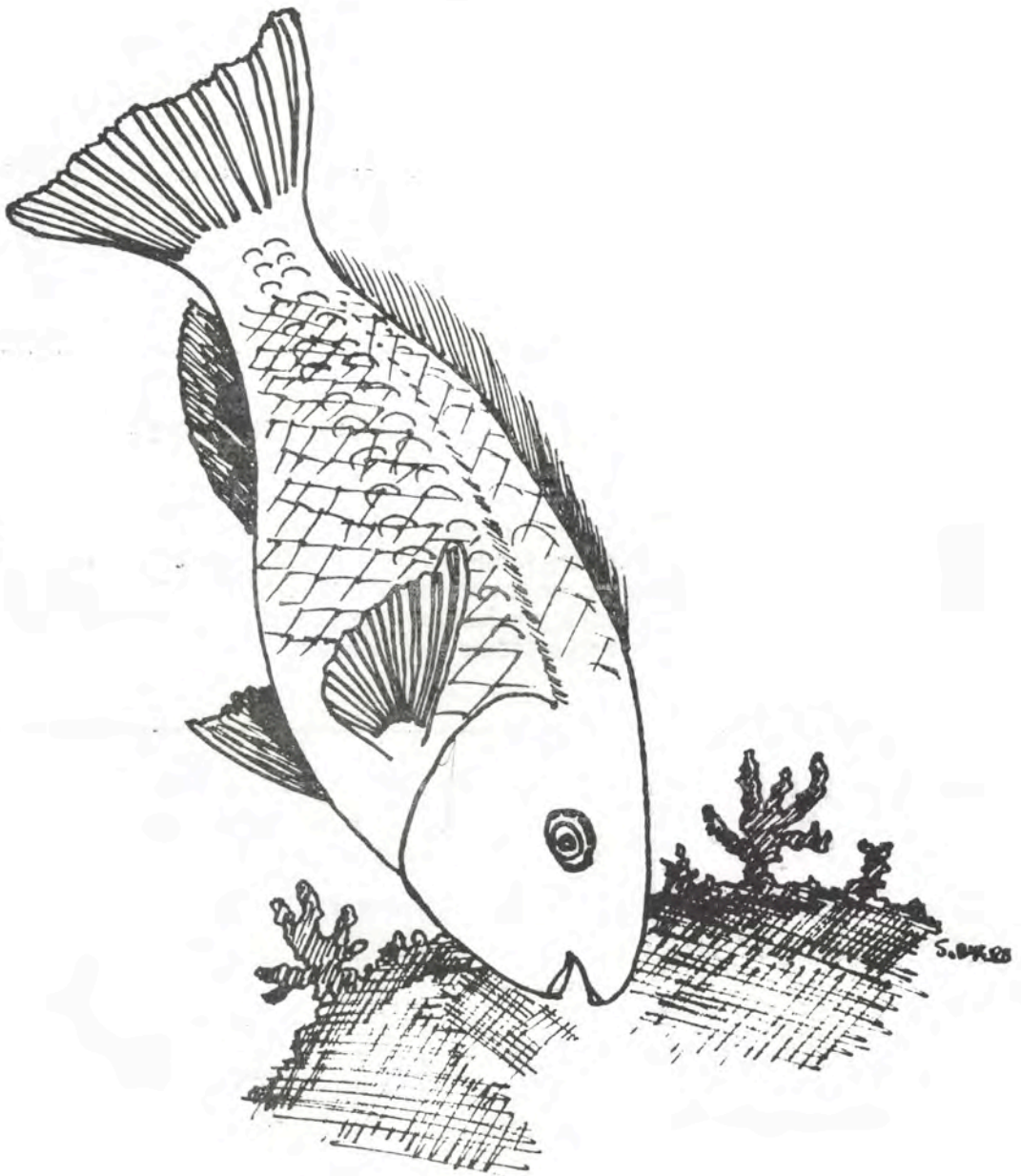
See if you can remember theanswers to the following facts

1. Name three types of reefs found off Queenslands coastline.
2. Name the four parts of a reef.
3. Where do the waves break on a coral reef?
4. Which area is refered to as the low energy zone?
5. Why is it called this zone?
6. Why is the reef back a different shape to the reef front?
7. How do sediments form at tghe base of the reef front?
8. How deep do you estimate the coral zone in the reef to be?
9. Where are wall reefs found?
10. What makes them different from fringing reefs?
11. What does the term, "a crosssection" mean?
12. Why are platform reefs so named?
13. What is found usually at the end of a platform reef and why?
14. There are two zones of coral in a platform reef. What are they and why are they so named?
15. Divers often refer to a zone called the "drop off". What are they refering to?
16. Is the drop off a high or low energy zone? Why?
17. What is the windy side of the reef called?
18. What is the other side called?
19. Which side of a platform reef would you anchor your boat in a Northerly?
20. There are cracks and crevices in the drop off zone of a platform reef? How do you think they got there in the evolution of the reef?
21. Draw a crosection of a intertidal area on a coral cay, from the beach to the dropoff, marking the zones.
22. Name three islands that are located on platform reefs.
23. What is a coral cay?
24. Can mangroves grow on coral cays and if so at what latitudes?
25. Name 5 differences andthree similarities between wall and platform reefs.
26. What is a fringing reef, how was it formed with reference to the ice ages and name any two islands that have them on Queenslands coastline.
27. If you wanted to go to each of the following islands, which port would you catch a boat out of? Lizard Is, Green Island, Heron Is, Great Keppel Island, Low Islands. Summarize your answers in a table.
28. What plant grows in abundance on Northern Fringing reefs?
29. What is a fossil microattol?
30. Copy the following diagram and complete it from the data given in Fig 50.



CHAPTER 5

SOME REEF ORGANISMS



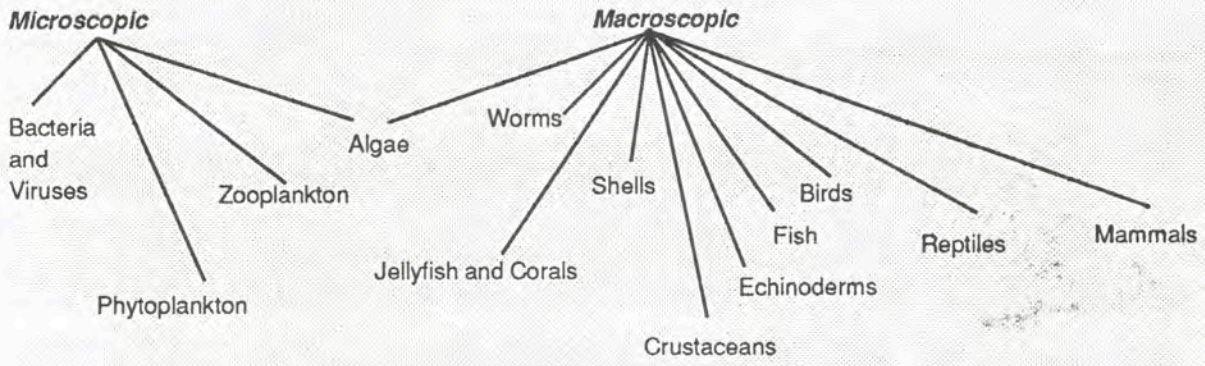
The reef has possibly the greatest diversity of life in the world. To even attempt to describe its richness would fill volumes of encyclopedias.

A discussion of reef organisms can be divided into *two sections:*

Part A: A very brief coverage of the animal and plant groups found on the reef

Part B: Individual research by you to detail as much as you can about the Biology of one reef creature.

Part A: A division of reef organisms



MICROSCOPIC ORGANISMS ASSOCIATED WITH THE REEF

The diagrams below show some of the marine microscopic plankton that can be found around reefs. Plankton means floating life. Plankton forms part of food chains for everything in the sea and over ninety percent of people who use the sea never know it is there, let alone see it. In *Fisheries Biology*, another unit in this series, you had the opportunity to look at some local plankton, but the next exercise concentrates on some reef plankton.

Class Activity ***Reef Plankton***

Purpose:

To prepare a wet microscope mount of some reef plankton, identify, draw and name a number of plankters.

You will need:

Students microsope
Reef Plankton sample
Microscope slides, cover slips and eye dropper

What to do:

Prepare a wet mount of two drops of marine plankton, your teacher will show you how.
Make line drawings of any six plankters you can see.

Fig 51: Some microscopic zoo plankton

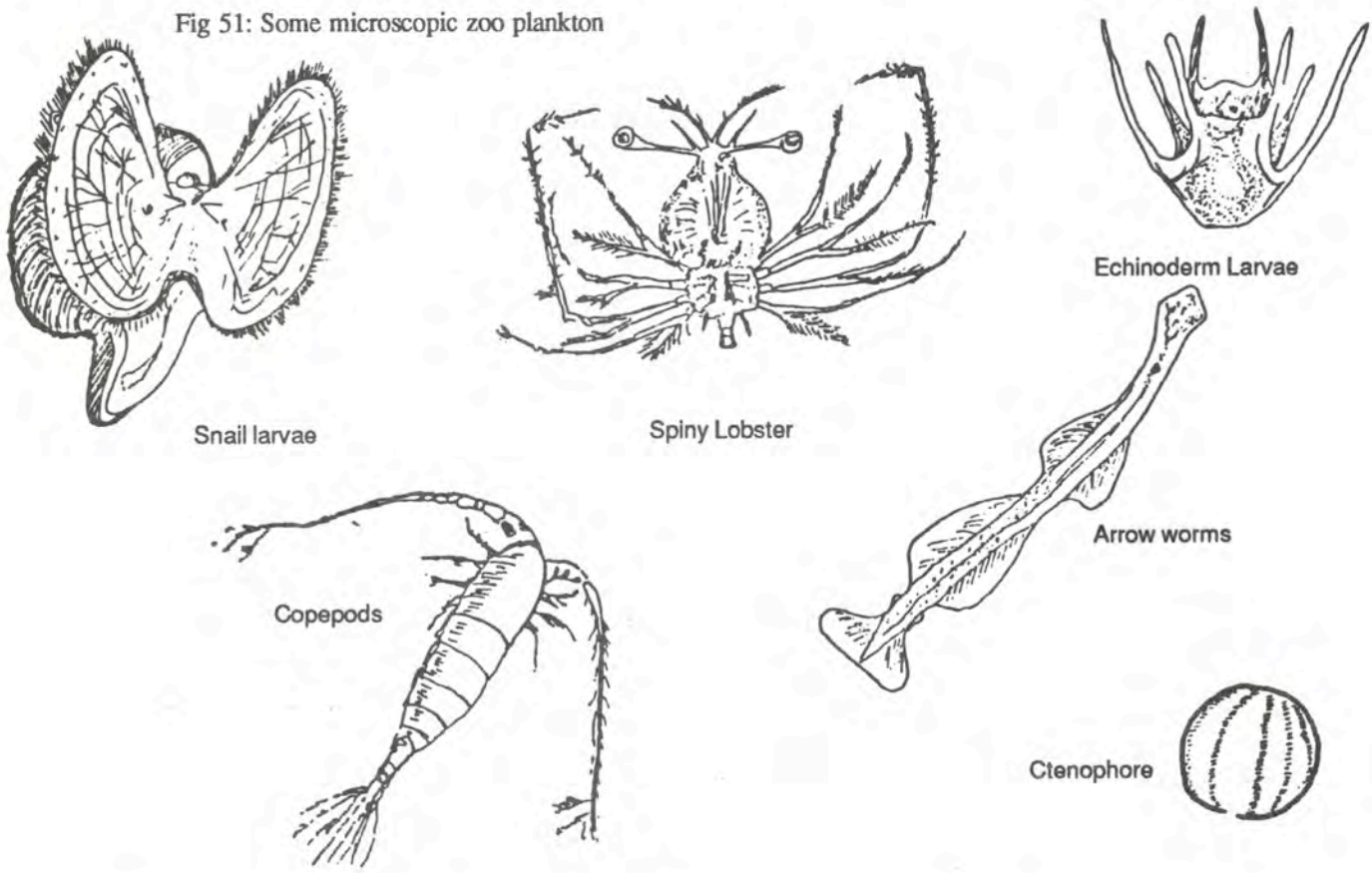
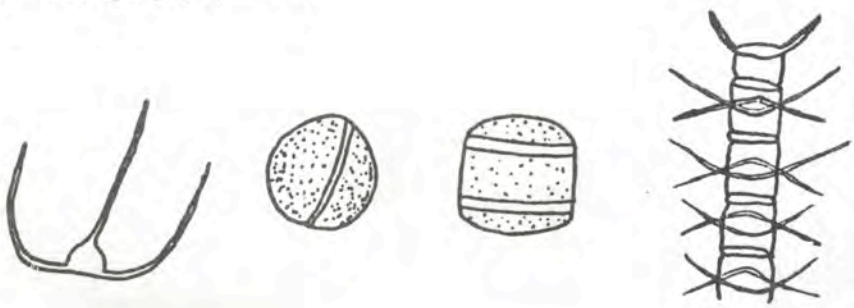


Fig 52: Some microscopic phytoplankton



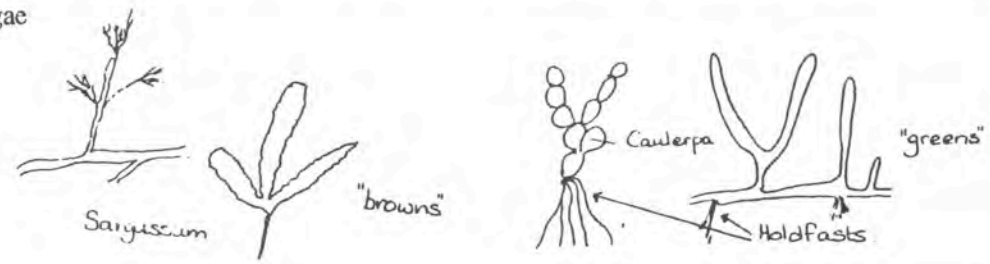
Some Plankton facts:

1. *Plankton* are the most abundant organisms in the oceans, the greatest proportion of which are the diatoms and dinoflagellates.
2. *Phytoplankton* are photosynthetic and provide a direct link with the sun's energy. They are the base of the food chain and provide much of the world's oxygen. If the phytoplankton of the sea are killed by pollution, then their is little hope for life in the sea.
3. *Zooplantkton* graze on the phytoplankton and in turn provide food for the other animals on the reef. Many of the larger reef animals' larval stages of development are in the plankton
4. Some dinoflagellates can reproduce very fast at certain times of the year to produce a scum on the water that is often incorrectly called *coral spawn*.

Algae

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

Fig 53: Some algae



Corals

Corals belong to a group of animals called Coelenterates.

This is a large group of over 9 000 species, found on shores, reefs, and oceans of the world. Well-known and easily recognized animals such as jelly fishes, anemones and corals, are included in this group.
Many species are attached to the reef itself, often forming large or small colonies, and others are free swimming in the sea . The basic body form is that of a polyp with a single external opening, the mouth, surrounded by tentacles in which there are stinging cells called cnidoblasts,(Figure 55) containing coiled threads, the nematocysts. These enable the animal to paralyze its prey.

The toxicity of these cells varies considerably, some being extremely potent. Perhaps the species best known to man, from this point of view, is the Box Jellyfish which has killed a number of people in Queensland over the past twenty years.

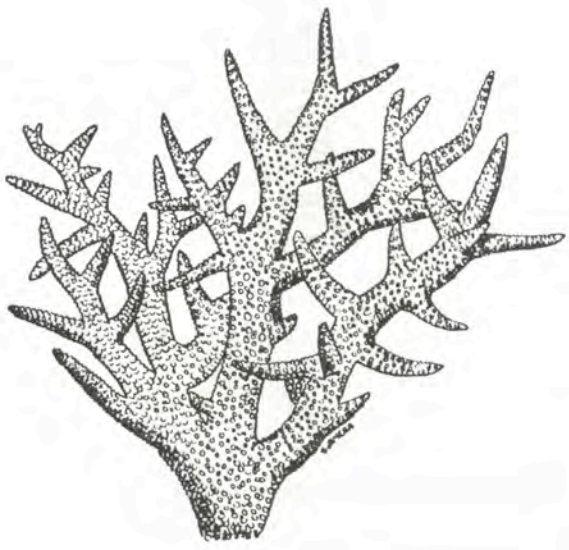


Fig 54: Branching coral

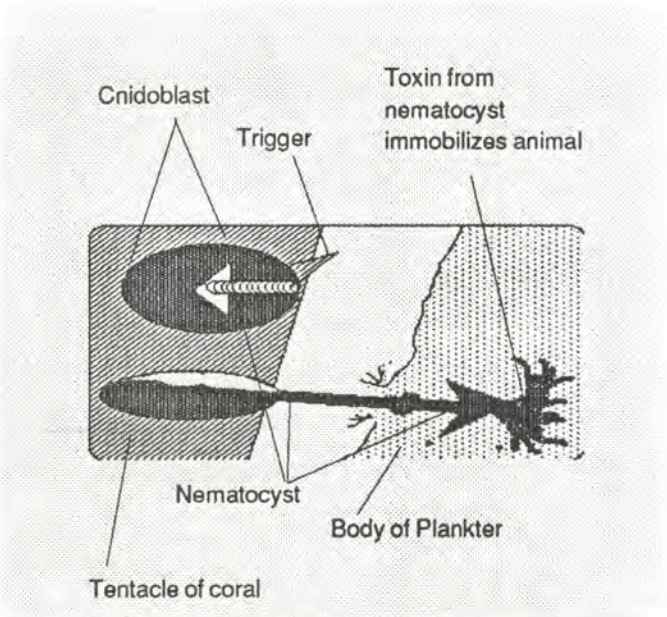


Fig 55: Cnidoblasts of Coelenterates

The polyp has a simple structure.

It is very similar in shape and build to the common sea anemone, see fig 63, but it is generally smaller and it secretes a small cup-shaped structure of limestone (at its base) known as a corallite.

The corallite provides support and protection for the soft-bodied polyp which is able to retract when not feeding. The tentacles are found uppermost and it uses these to feed.

While coral colonies may form a great many shapes and sizes due to different skeletal patterns, the coral polyp, which is the fundamental unit, remains the same.

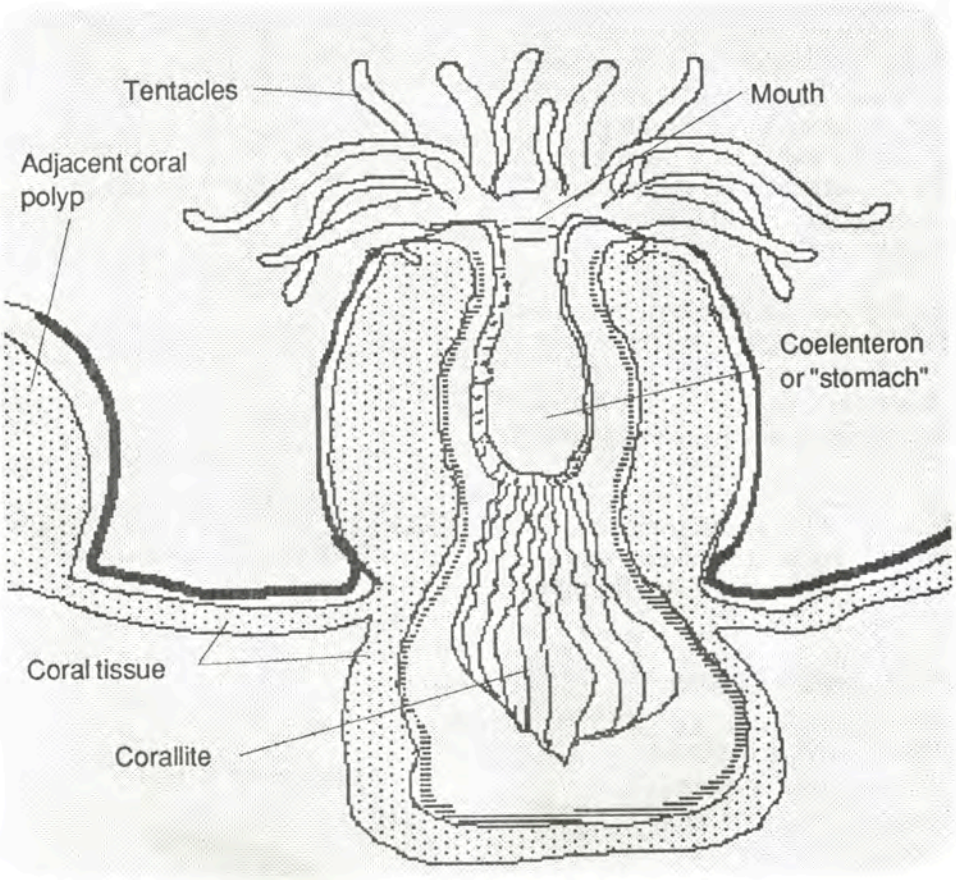


Fig 56: A Coral Polyp

Although some corals are solitary forms in which the single polyp may reach quite a large size (as in the Mushroom Corals), most form colonies and in these, the polyps are rarely much more than a few mm in diameter.

Each polyp lies fixed within its limy cup, the corallite, which has been secreted by its lower outer layer of cells. In all colonial species this is interconnected with the polyps adjacent to it.

Thus the walls of the column of each polyp lie above the cup skeleton and since they connect with those surrounding it, the entire colony is connected horizontally and the living polyps are, in reality layers of animal tissue lying above and completely covering the calcareous skeleton.

The white dead skeletons of the corals are things of great beauty, minutely sculptured with intricate designs. These designs are the important structures used in the classification of corals.

Coral Growth

Corals as a group are difficult to define as it generally includes three types of animals;
1. the hydrozoan corals,
2. the soft corals, and
3. the stony corals.

The most important members of the whole Barrier Reef are the reef builders themselves, the true or stony corals. The builders are tiny animals called coral polyps, which by building a skeleton of limestone and by dividing to form new polyps create the living structures known as colonies. A coral colony is not a group of individuals living together for the common good, but rather the result of growth and division of an original founder polyp.

In corals which grow as sheets or layers, new polyps are added on around the edge of the colony. Branching corals grow by adding new branches as well as extending existing ones. In mound-like colonies , new polyps are added within the surface of the mound. As the colony grows, polyps pull themselves upwards and lay down a new 'floor' of skeleton.

The thichness of the floor depends on weather conditions and other factors, so that accumulation of layers of floor over the years provides a calendar, somewhat like the rings in a tree trunk. The layers of floor allow the age of the coral to be estimated, and unusual events in its history to be noted.

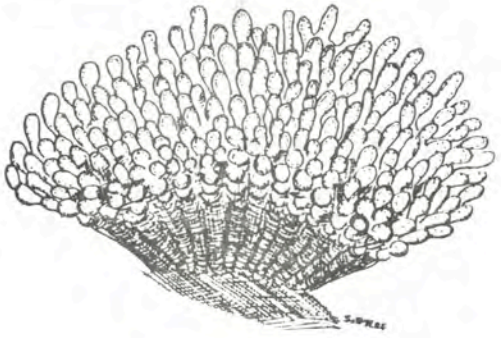
Colonies of stony corals occur in many different shapes and the intricate sculpturing of some coral skeletons is very beautiful, while others are so fragile it is difficult to understand how they survive.

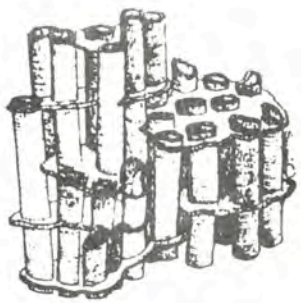
The most common growth forms are the following:

1.branching colonies that resemble trees or shrubs,
2.round massive colonies that resemble boulders
3.plate or 'table' coral that grow as broad circular upward-facing colonies usually supported by a central column.,
4. corals that occur as thin sheets sometimes called 'leaf' coral,
5.encrusting colonies that grow closely over the reefs surface,
6.free-living corals that occur unattached on the sea bottom and
7.solitary corals that consist of a single polyp, often relatively large. Each of the above types has specific requirements for growth e.g. deep, shallow, quiet, surf waters, can withstand being uncovered at low tide or not.

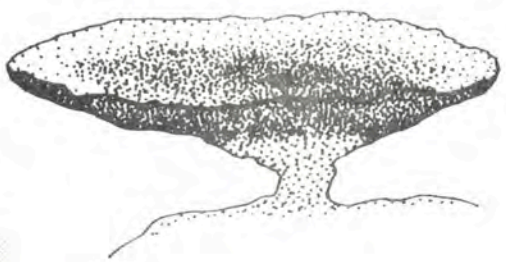
These differences among species result in rather specific reef forms developing under the impact of the environment.

Fig 57: Some Coral Forms

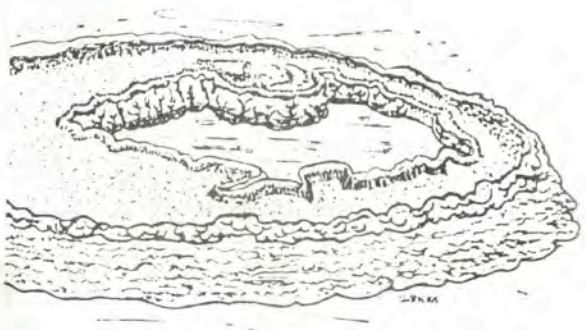




Dish coral



Mushroom Coral



CORAL REPRODUCTION

Coral polyps owe their great success to their ability to reproduce.

They can do this sexually by producing male and female gametes (sperm and eggs) which unite to form tiny rounded larvae called planulae. In some corals, separate colonies have either all male or all female polyps, while in others both sexes occur in the one colony.

Sometimes each polyp is both male and female, and releases a bundle of eggs and sperm into the seawater on only one or two nights each year.(see fig below)

The egg and sperm package breaks open and fertilization takes place at the surface of the sea. They grow into a *Planula*. The millions of tiny planulae which are formed live freely in the water for up to 30 days as plankton, swimming slowly through the water using its hair like projections for locomotion.

Sometimes the sperm and egg are fertilized inside the polyp. In this case the planulae are released from the polyp.

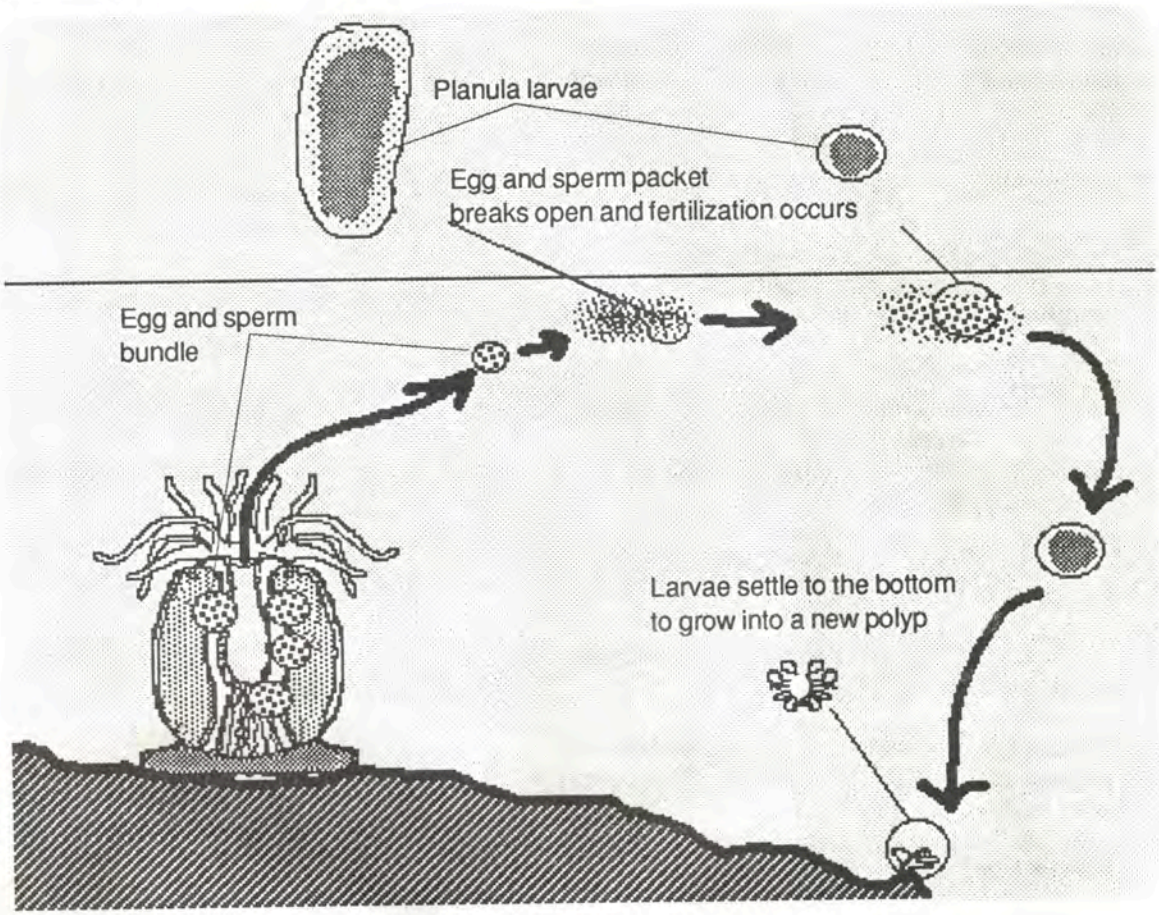


Fig 58: A coral sexual life cycle

After a variable period of time, it will settle and grow into a polyp. First it begins to secrete a base of limestone and then develops tentacles and a mouth and soon it is a functional polyp able to capture food.

It begins to bud off a small additional polyp from one side, then another and so on until a small coral colony is formed. During this early stage mortality is often very high but the large numbers of planulae released compensate for this. This is the **second form** of reproduction not mentioned so far.

There is often considerable competition for space on a reef and the small colony may be eliminated by adjacent corals or other organisms which restrict the light or which may even eat it.

Because they are made up of many polyps, coral colonies can also reproduce asexually, that is, parts of the colony which break off can survive as separate colonies.

This happens most often with branching corals, although some novel methods, such as producing separate buds, occur in some rounded colonies.

This type of reproduction is especially useful in places where there is not much solid space for the settlement of planulae, such as the sandy floors of reef lagoons. It is not known how long corals live and it undoubtedly varies from species to species.

Large brain corals have been recorded in one location for many years and life expectancy in corals to a large extent depends upon environment.

Favourable environments that are stable over many years would be conducive to coral colonies attaining a great age.

CORAL FEEDING

Corals feed by extending their tentacles armed with stinging cells and catching microscopic floating animals (zooplankton), from the waters around them.

When the tentacles encounter an animal (such as a shrimp, or an early larval stage of some other reef animal) the barbed darts of the stinging cells are fired to paralyse and hold the prey.

Then with a graceful bending motion the tentacle passes the morsel to the mouth.

The prey is broken down in the polyp's hollow body cavity, the coelenteron, see Fig56.

Through the connections between polyps it becomes part of the nutrition for the whole colony. Most coral stings are not sufficiently powerful to be felt by humans, however certain hydrozoan corals can cause mild stinging and are called ' fire corals'.

Sometimes corals also use nets of mucus to ensnare bacteria and small animals. Organic materials in the seawater passing into the polyp may also supply some nutrient needs.

Most corals feed at night and at this time their polyps are fully extended in search of food. During the daytime they are retracted within their corallites. The night feeding pattern of corals probably occurs because zooplankton reefs are most active at night.

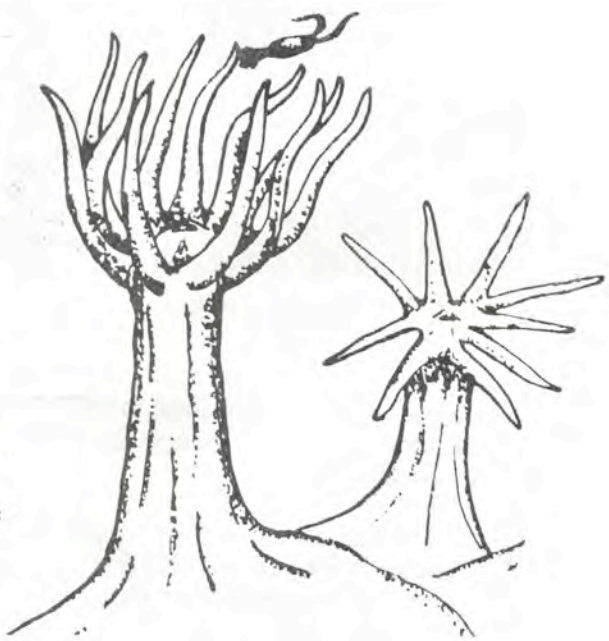


Fig 59: Corals feeding (After Project Neptune Project 14, Illustration reproduced with permission)

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*.

The relationship between the zooxanthellae and the coral is one of mutual benefit (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 probably food made by the plant cells.

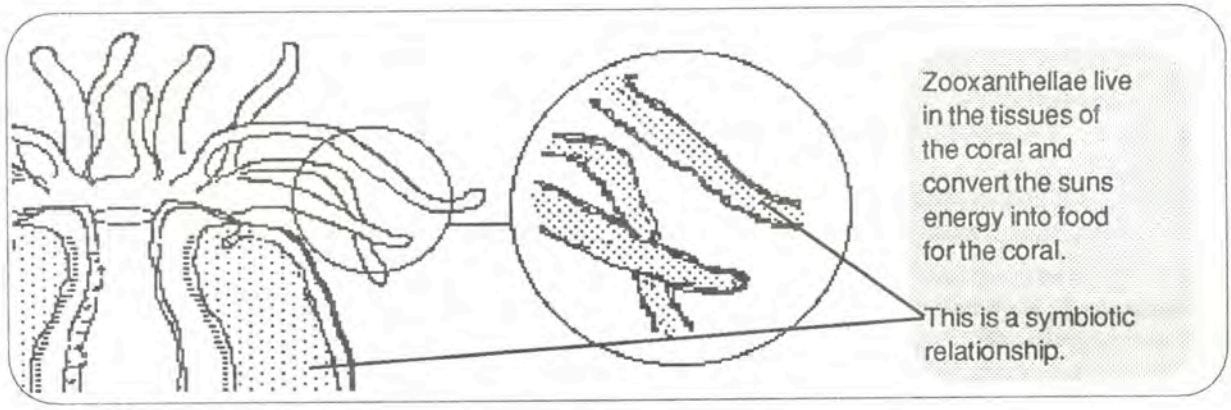


Fig 59: The xooxanthellae are a symbiotic relationship

During the day, reef-building corals usually have their polyps retracted or pulled back into their limy skeletons.

This allows the microscopic plants to absorb as much light as possible. At night the polyps extend or come out of their skeletons to wave about and feed on tiny animals.

Reef-building corals flourish in shallow tropical waters, rarely being found below depths of 60 meters, and with water temperatures ranging between 20°C and 30°C. Since all plants require sunlight , it is considered that the presence of the zooanthellae is a determining factor for the depths at which reef-building corals flourish.

Recent scientific research has begun to explore the question of how much nutrition the coral obtains from zooplankton on the one hand and from its zooanthellae on the other.

Some scientists believe that coral obtains most, if not all, of their nutriment from their zooanthellae, while others seem to think zooanthellae play only a minor role in providing basic nutrition.

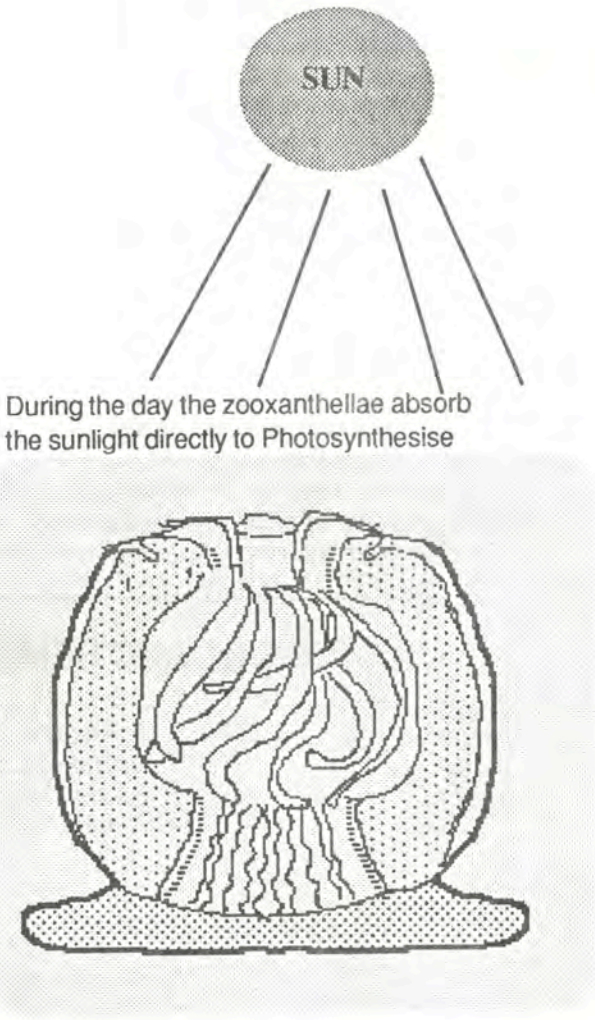


Fig 61: Corals during the day time

Assignment 3

Purpose

This assignment provides you with the opportunity to research one or two animals or plants found on the reef and present a short seminar on that chosen animal or plant.

It may be done at the reef itself or if you are unable to attend a reef trip, try to make it to Sea World on Queensland's Gold Coast, and complete the Project Neptune project materials.

You will need

Fig 62:Research books

If going to Sea World,
A copy of the Aquarium Projects (select three)

If using your school library
Reference Books , here are some , your library may have others

Bennett, I. The Great Barrier Reef, , Lansdowne Press 1980
Carcasson, R. H., A field guide to Reef Fishes of the Tropical Australian and Indo Pacific Region. Collins, Sydney, 1977
Coleman, N. Australian SEA FISHES North of 30°, Doubleday Sydney 1981.
Endean, R. Australia's Great Barrier Reef, University of Queensland Press, 1982
Hargreaves, V.B. The Tropical Marine Aquarium, McGraw-Hill Book Company, New York, 1978
Mather and Bennett, (Eds), "A Coral Reef Handbook", Coral Reef Society, Brisbane, 1984
Readers Digest, Book of the Great Barrier Reef, Readers Digest 1984
Sanger, P. A Divers Guide to the Great Barrier Reef, Scientific Committe for the AUF 1977
Thresher, R.E. Reef Fish, Behaviour and Ecology on the Reef and in the Aquarium, John Bartholomew and Sons Limited, Edinburgh 1980
The Australian Academy of Science, "The Web of Life", 3rd Edition, Australian Academy of Science, David Morgan Editor, 1986

If going to the Reef on an Excursion
Write for the Project Reef Ed Materials from the Marine Park Authority

What to do

1. Look over the next few pages and select an animal, pages 47 - 54 or a plant or bird from Chapter 3
2. Try to answer some or all of the questions posed. Make up some of your own and answer them.
3. Assemble your information and present it as follows:

YOUR REPORT AND SEMINAR

1. A title and purpose
2. A drawing, illustration or photograph
3. A description of the habitat in which the organisms lives
4. A statement of either:-(select any *two)*
   - (a) what it feeds on
   - (b) whose its predators and prey are
   - (c) how it reproduces
   - (d) how it is affected by humans
5. At least *two* adaptations it has to assist it survive
6. To be ready by the due date and to be in your own handwriting or typed without error.
7. There should be no spelling or gramatical errors

PROJECT 1: SEA ANEMONES AND SPONGES

Here are some questions you may like to consider in your project.

Q1. What is the difference betwen an anemone and a sponge?
Q2. What are spicules and where are they found?
Q3. What is a *coelenteron,* and for what is its purpose?
Q4. Are sponges commercially harvested? If so where?
Q5. What is budding and how does it occur?
Q6. What are the names of the stinging cells in the tentacles of the sea anemone called?
Q7. Find out about the Anemone and the Clownfish. Look up Sea World's Project Neptune Project 19.
Q8. What is Acclimitization and how does it affect the the Clownfish? You can find the answer in Project 19.
Q9. List any five Scientific names for the Sea Anemone. Now list three different species with the same generic name.
Q10. How is water circulated around the sponge.
Q11 How many cells thick is a sponge?
Q12. Are sponges inportant to humans? How?
Q13. Write a sponge poem.
Q14. Research how an Anemone feeds.
Q15. Are any Anemones poisoness to humans? If so which ones?

Fig 63 Sea Anemone

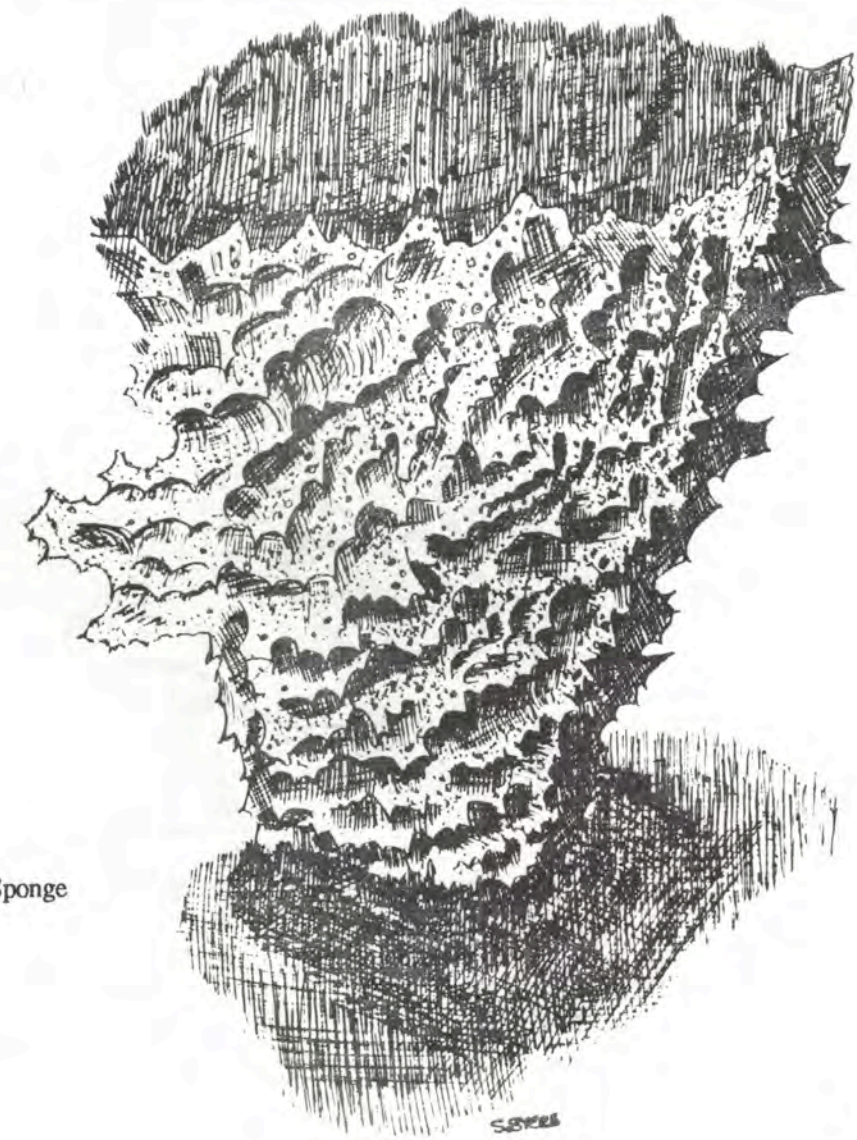


Fig 64. Sponge

PROJECT 2: CONE SHELLS AND GIANT CLAMS

Q1. To what Phylum do cone shells belong?
Q2. Are Clams in the same Phylum? If not, to what Phylum do they belong? If so, to what class within the Phylum do they belong?
Q3. Are some cone shells poisoness? If so which ones?
Q4. Can a giant clam crush your hand?
Q5. Do clams have symbiotic bacteria? What do they do?
Q6. What is a radula?
Q7. Are cone shells collected? Why?
Q8. Do cone shells have eyes?
Q9. Is the term cone shell a good name for the animal? Why?
Q10. List three differnent cone shell species from the same genus.
Q11. How do Clams feed?
Q 12. Find out about the incurrent and out currents of clams?
Q13. What are the relatives of clams?

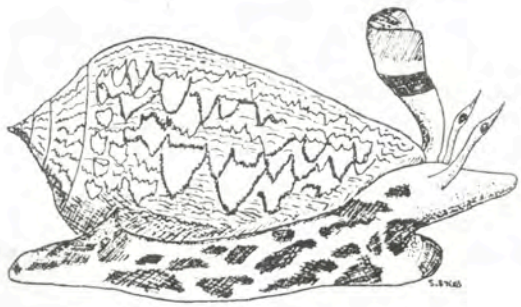


Fig 65: Cone Shell

Fig 66: Giant Clam

PROJECT 3: ECHINODERMS

Q1. What does the word echinoderm mean?
Q2. Is a Sea Cucumber an Echinoderm? Does it have another name?
Q3. Are Sea Cucumbers harvested and exported for their meat?
Q4. If so where and by who? Is there any money to be made from the export trade?
Q5. Are permits required to collect them on the Barrier Reef?
Q6. Why is the Crown of Thorns such a topical newspaper animal?
Q7. How does it eat its prey?
Q8. What is its natural predator?
Q9. Which Queensland Scientist is constantly monitoring its progress.
Q10. Are the thorns dangerous? What happens if you stand on one?
Q11. Do sea cucumbers play chemical warfare and why and with whom?
Q12. What are sea eggs and where are they found. Sea Worlds Project 5 has some good ideas.

Fig 67 Starfish

Fig 68: Spiny Sea Urchin

Fig 69: Sea Cucumber

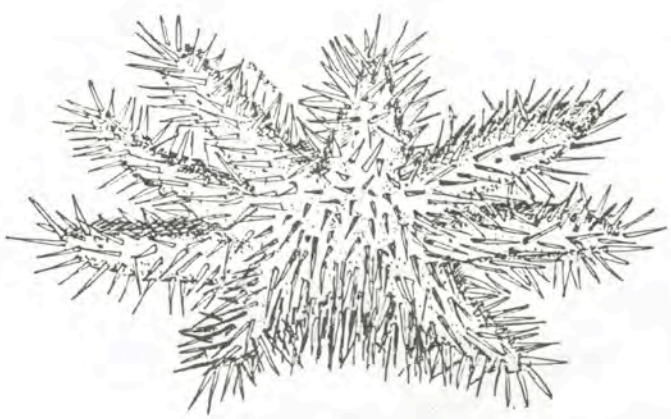
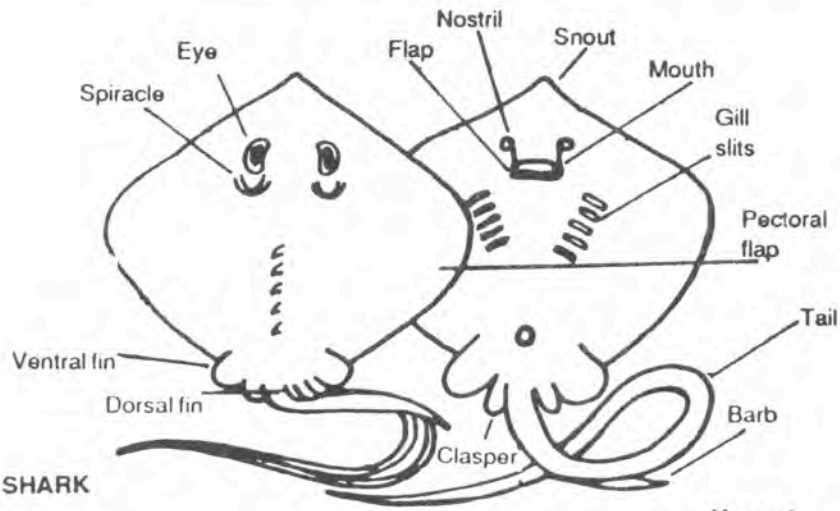


Fig 70: Crown of Thorns Starfish

PROJECT 4 FISH, SHARKS AND RAYS

Q1. What is the difference between a shark and a ray?
Q2. How do sharks breathe?
Q3. What is the lateral line used for in sharks?
Q4. How do sharks swim? Research the fins that are used for turning up and down, sideways, propelling. Make outline drawings of the shark explaining your ans.
Q5. Do fish have swim bladders? How do they use them and can they make sounds?
Q6. What is cartilage? Which fish are cartilagenous?
Q7. Find out about fish scales. Can Scientists age fish by them? If so, how?
Q8. Are all sharks dangerous? How many shark attacks have there been in Queensland over the past 10 years?
Q9. Fig 73 shows a Goby andShrimp. Research how these two animals live together. What is the special relationship that they have between each other?
Q10. Obtain a copy of Sea World's Project Neptune Projects 26 and 27 and use this information to further your research



EXTERNAL FEATURES OF A GENERALISED SHARK

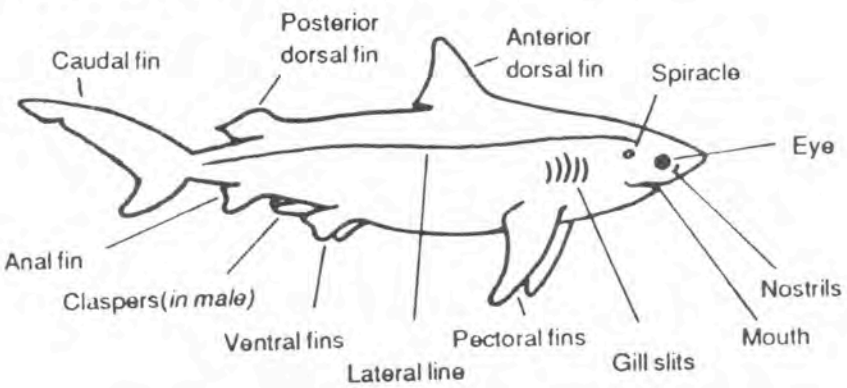


Fig 71: External features of a Ray Diagram from Sea World's Project Neptune.

Fig 72: External Features of a Shark Diagram from Sea World's Project Neptune

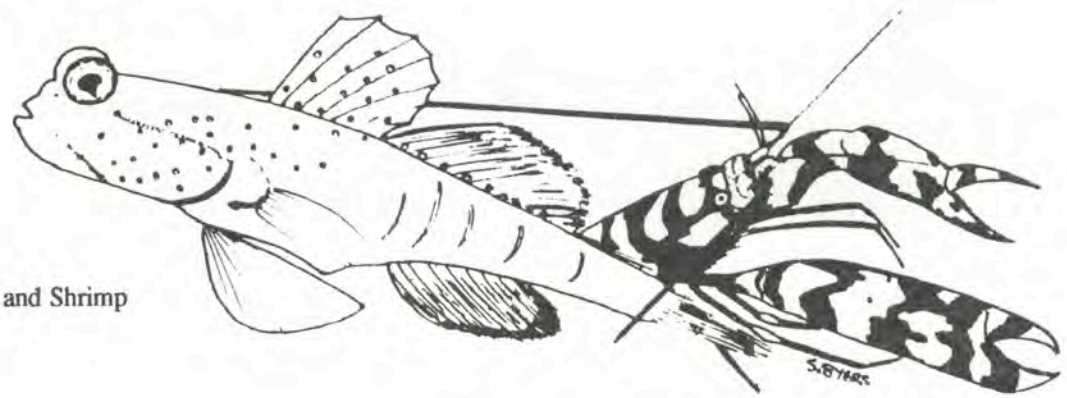


Fig 73: The Goby and Shrimp

PROJECT 5: REEF FISH AND CLEANER WRASSE

Q1. Which species or genus of cod is shown in fig:74?
Q2. How big do you think the Parrot Fish is in Fig 75? How big do Parrot Fish grow?
Q3. What special contribution do Parot Fish make to the formation of Coral Cays?
Q4. What is ciguateria and in which fish is it found? What is the treatment for it?
Q5. Write to the Department of Fisheries for some fish pamphlets and research the information in each.
Q6. Recordthe habitats of each of the fish shown in the diagrams to the right.
Q7. Now list at least *three* adaptations for each of these fish.
Q8. The cleaner wrasse has a special relationship with fish on the reef. What is this relationship called? How is it defined and of what importance is it to fish?
Q9. Obtain the Pamphlet from Marine Parks on Recreational Fishing in the reef and make a list of the species that are protected.

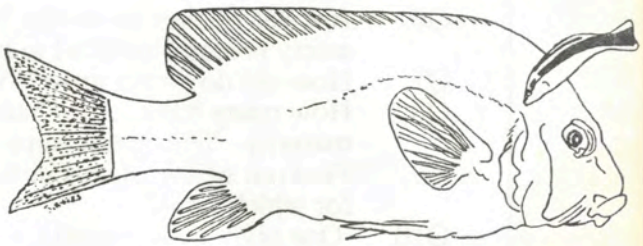


Fig 74: Cod and Cleaner Wrasse

Fig 75: Parrot fish

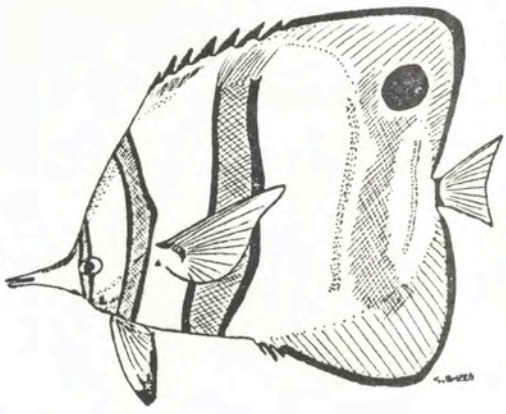


Fig 76: Beaked coral fish

PROJECT 6 TURTLES

Q1. What types of turtles are found in the Barrier Reef Region?
Q2. Why do they need to be protected?
Q3. Were turtles commercially harvested in the past? If so where and by whom?
Q4. Fig 77 shows turtles mating. Find out when they mate and how the young are born. The National Parks has a excellent pamphlet on this.
Q5. To what Class do Turtles belong? What are the features that place turtles this class?
Q6. Are Sea Snakes related to Turtles? How dangerous are they and what safety precautions need to be taken when diving with them.
Q7. How old do turtles grow? Where do they go when not on the reef?
Q8. How many baby turtles hatch from a clutch? How many survive to maturity. Who is the animals greastest predator?
Q9. Find out which islands in the Capricorn Bunker Groups are rookeries for which turtles.
Q10. One night on an island far far away, Scientists recorded the greatest number of turtles on a beach on the Barrier Reef. Which reef was it? How many turtles were recorded?

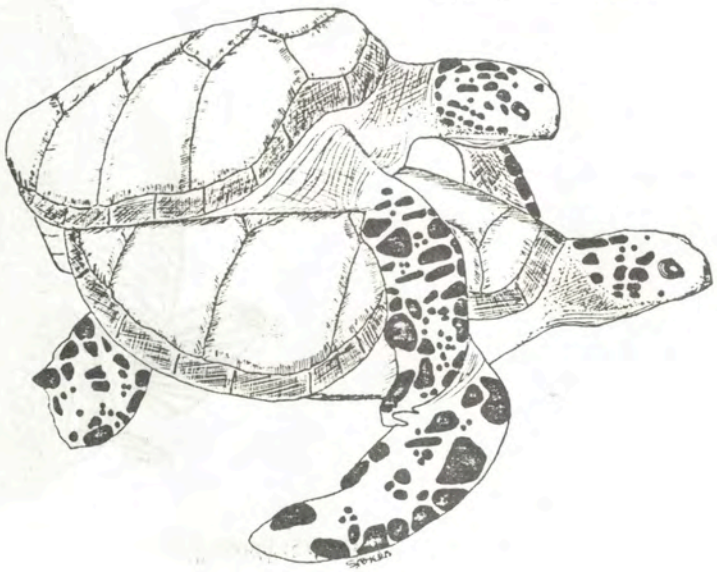


Fig 77: Turtles mating

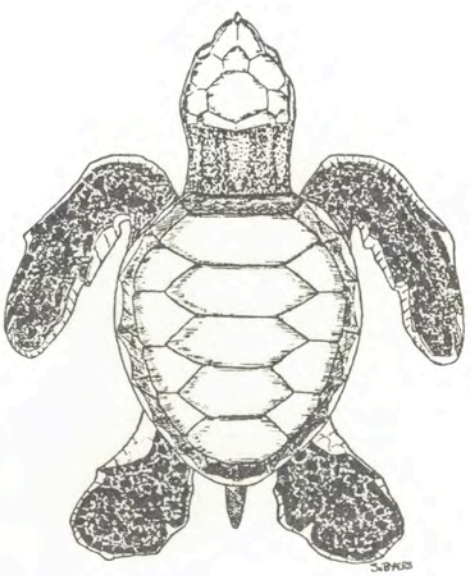


Fig 80: Baby Turtle

PROJECT 7 DOLPHINS AND DUGONGS

Q1. To what Class and Order of animals do Dugongs and Dolphins belong?
Q2. How do Dolphins breathe?
Q3. Do Dolphins have hair?
Q4. How do Dolphins locate their food and what do they eat?
Q5. How does a baby Dolphin get its milk?
Q6. Where do Dolphins live? Do they migrate or stay in the one place all the time?
Q7. What do Dugongs eat? Where are they found? Are they hunted? If so who hunts them and for what reasons?
Q8. Are Dolphins as intelligent as humans? Give reasons for your answer.
Q9. Write to Sea World on Queenslands Gold Coast and ask for their booklet on Dolphins ands Whales.
Q10. Why do Dugongs need protecting?
Q11. What is another name for a Dugong?

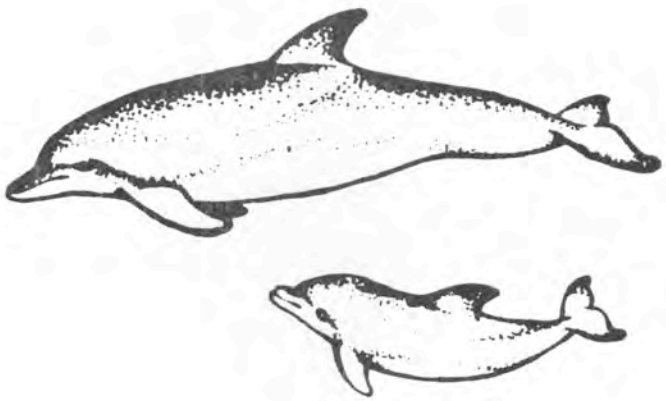


Fig 82: Dolphin and calf from Sea World's Project Neptune

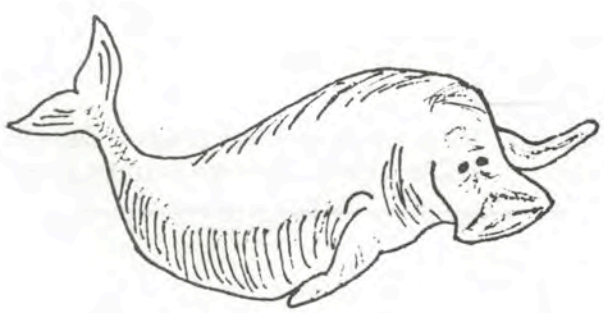


Fig 83: Dugong

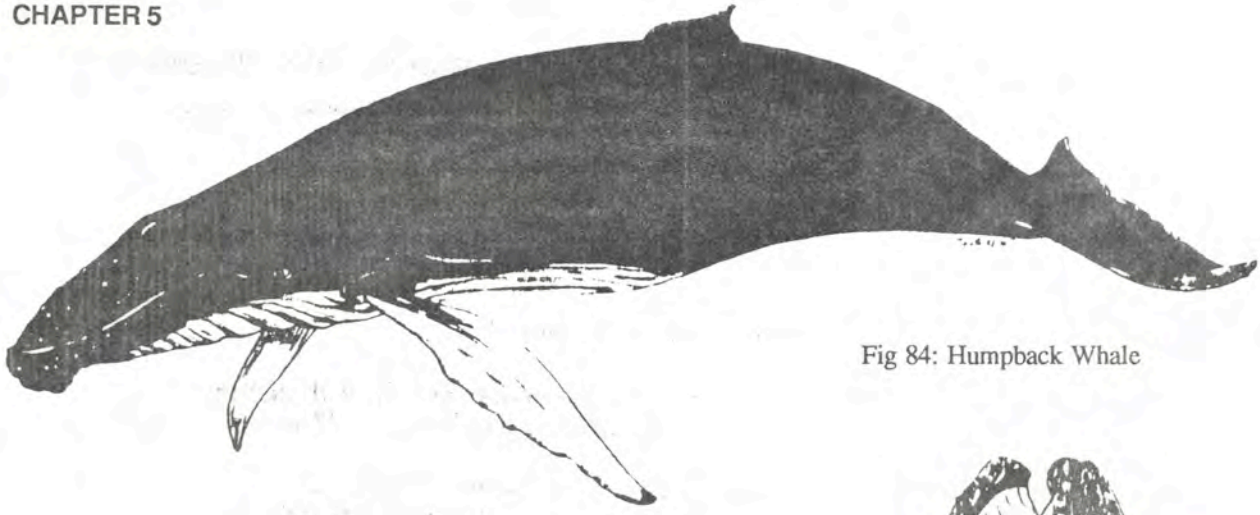


Fig 84: Humpback Whale

PROJECT 8 HUMPBACK WHALES

Q1. Where are Humpback whales found?
Q2. Once they were hunted in Queensland in the past. Where was the last whaling station, how many people did it employ and why did it have to close down?
Q3. Where do humpbacks migrate to?
Q4. Why do they migrate?
Q5. To what Class of animal does the Humpback belong? Why?
Q6. How big do humpbacks grow?
Q7. What other Whales are found in Qld?
Q8. How do Whales reproduce? How long is their gestation period?
Q9. How helpless are baby whales?

Fig 85: Whales mating

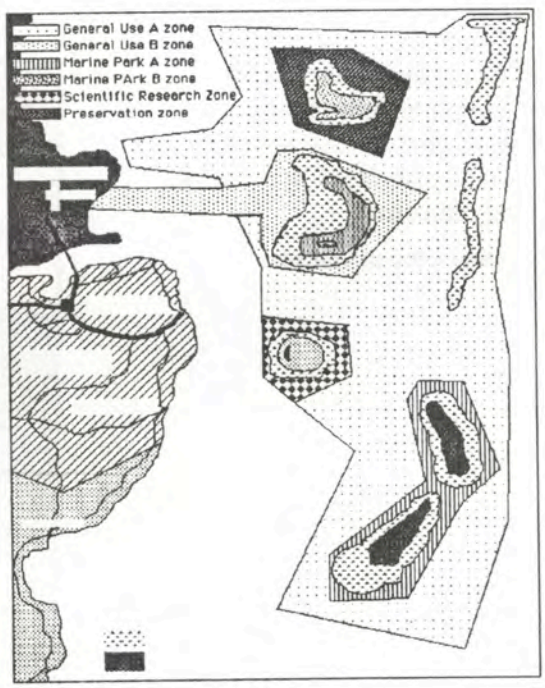
Ed. Note: This concludes the project section. There are many other projects that can be done. When Project Reef Ed comes out, your teacher will be able to copy many more projects for you.

Your Talk:

This needs to be well planned and delivered. Make sure you are organised, have all your notes ready, and have your props ready. (These may be model fish, overhead transparencies, charts or reference books). Keep within your time and try out your talk beforehand)

CHAPTER 6

REEF MANAGEMENT



In Novemeber 1970, Isobel Bennett wrote,

There are two extremes among the alternatives for the development of the Great Barrier Reef:

The preservation of a unique national heritage - the conservation of its living resources in a manner which ensures their continued survival - the selection of sites and the planning of tourist facilities to enable the greatest number of visitors to enjoy the reefs without detracting from or destroying their natural beauty

or

The utilization of all natural resources to their fullest extent in a short term interest of the national economy of the country - regardless of whether or not this exploitation results in the despoilation of the reefs and possible death of the living communities of animals or plants which created them.

The responsibility for the Great Barrier Reef's future development within these extremes lies with all Australians.

The overall plan for the administration of the development of the Great Barrier Reef province as an entity is an objective for which we must all strive..."

Page 173 The Great Barrier Reef, Bennett, I., 1971, Lansdowne Press.

That year, Governments in Australia, had allowed mining companies from within Australia and overseas to have permits to search, drill and mine for oil and gas off Queenslands coastline.

Figure 86 shows these leases.

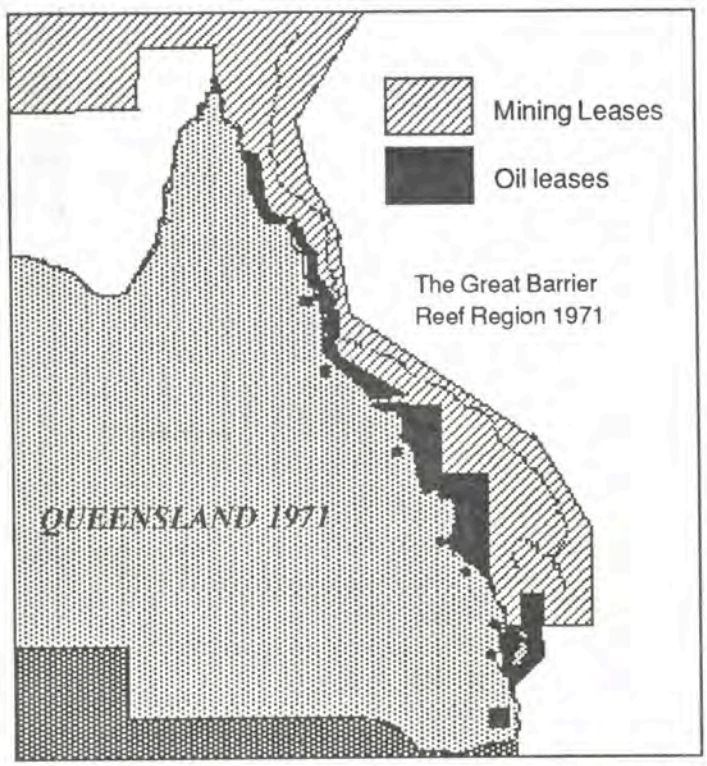


Fig 86: Oil and mining leases, Qld 1971, Source Bennett 1971, The Great Barrier Reef, Lansdowne Press.

In California, similar leases have been granted. Figure 87 shows five small dots in the background. These are five oil rigs near Los Angeles, one kilometre apart.

Fig 87: Offshore oil rigs, Carpentaria, USA.

Figure 88 shows the thirteen pumps, ten meters apart on shore which run along a road between Los Angeles and San Franscisco. These pumps are used to pump the oil to storage containers located inland.

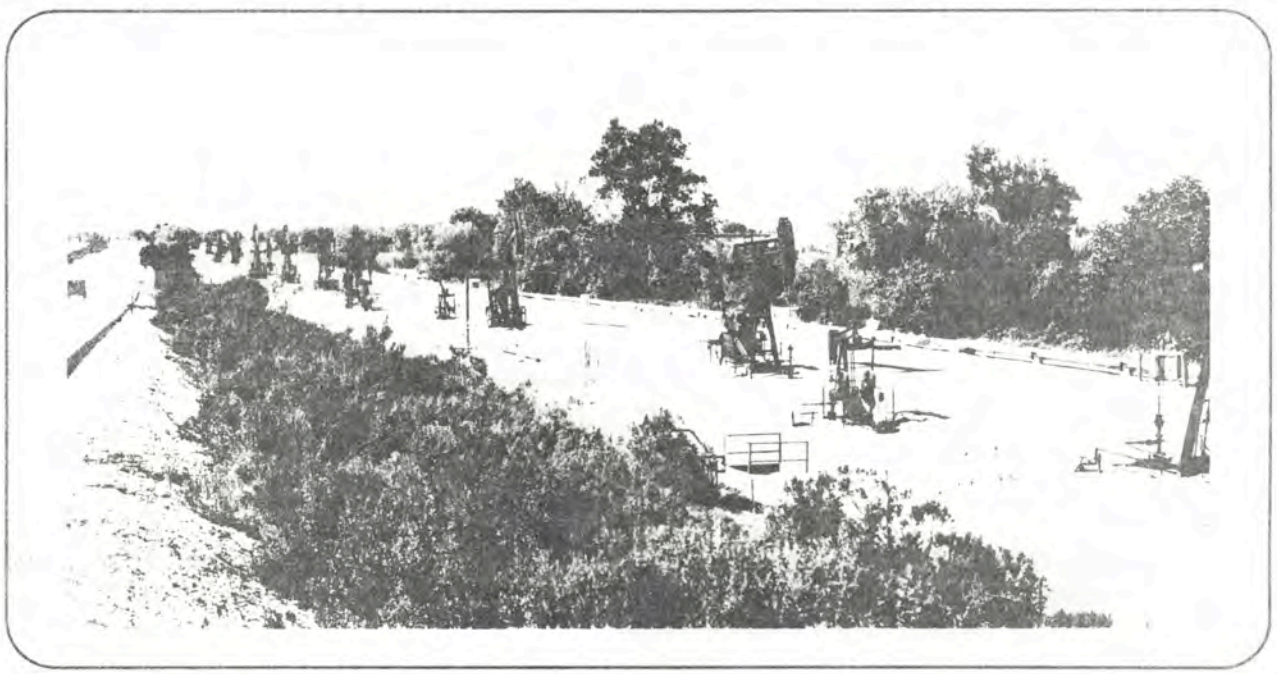


Fig 88: Beachside Oil pumps Carpentaria, USA

Eight years later , The Great Barrier Reef Marine Park, Capricorn Section, was declared.

The Government of the day, then decided not to allow mining or drilling for oil on the Barrier Reef.

Discussions between the State and Federal Governments set up a plan for joint management which lead to an act of Parliament. The Great Barrier Reef Marine Park Act of 1979 provides for the management of the Great Barrier Reef.

So the Reef has its own act of Parliament. The Reef is a world heritage listing which makes it special. Any elected government will have to convince world authorities of the need to drill for oil and mine the reef.

The Great Barrier Reef Marine Park Act, set up a Government Authority, The Great Barrier Reef Marine Park Authority who was responsible for the safe management of the reef. Officers were appointed, a building established at Townsville, and staff employed as public servants to manage the reef.

One of their jobs was to prepare a zoning plan for the Capricorn Section of the Reef. Some methods used by the Great Barrier Reef Marine Park Officers were:

(a) Local surveys of the people who used Capricornia
(b) Scientific Studies to establish inportant breeding sites
(c) Aerial Mapping and Surveying to map accurately the region
(d) Consultation with other Government Departments who used the region

These jobs were not easy. Nothing had been attempted like this ever before in the world on such a large scale. There were marine parks overseas, but none of the size of the Great Barrier Reef. What made their task even more difficult was the fact that many of the charts of the reef were not readily available so the Authority had to spend an enormous amount of time and money photographing, mapping and sounding the reefs.

The Capricorn Bunker section covered approximately 12,000 square kilometres of the most heavily used reefs in the area.

Some of the people who used the reefs off Queensland Coasts were:

(a) Commercial Fishermen
(b) Recreational Fishermen
(c) Tourists, Heron Island is a famous Tourist Resort
(d) Tourist Resort Developers, Hamilton Island in the Whitsunday group is a famous island development
(e) Educationalists, Trainee teachers, university students, school children are some examples of educational uses
(f) Scientists, At One Tree Island there is a Scientific Research Site
(g) Conservationists, The Queensland Littoral Society is a conservation group who study the reef
(h) Campers, local residents travel to islands such as North West to camp for holidays
(i) Photographers
(j) Scuba divers
(k) Shell Collecting Clubs
(l) Indigenous Peoples

The Marine Park Officers interviewed all groups in a Public Participation Programme. They produced brochures, leaflets, films and television commercials that sought to make the public aware of the need for them to help manage the reef.

As a result of a long and exhaustive effort, it was decided that because so many different types of people used the reef and for so many different reasons, a system was devised by which everyone, except the miners and the oil drillers, could use it.

This, the Park Officers called, MULTI-USER ZONING.

Stages of multizoning: An area of reef is zoned as Marine Park, clear maps are drawn showing the boundaries. The public is surveyed so as to identify the uses of that area. The Authority then draws up a proposed zoning plan and then gives it back to the public to prepare a submission for park use. Each of the interest groups is asked to prepare a submission for a public meeting which will be used as a forum for discussion about the zoning plan.

The Authority then makes recommendations to Parliament about the proposed zoning plans. The Parliament then debates the zones. The zones then pass from the House of Representatives to the Senate to be debated further. After all this is done, the zones become law.

Assignment 4.

Zone the Reef - A Classroom role play

(Based on an original idea by Dennis Bridger and Len Zell)

Purpose

To split the class into different user groups so as to conduct a meeting in which a hypothetical reef area will be zoned by the Marine Park Authority.

Optional extra

The Authority could then prepare a zoning plan and the class could an opposition and an elected government to role play a debate in the House of Representatives.

This takes about two weeks to prepare and organise fully.

Time Required

Three weeks for collection of information, group discussions, library research, preparation of report.
One full period for the group to role play the Authority, to present their zoning plan and their activities guide pamphlet.
One Eighty Minute Double Lesson for meeting for the interest groups to present their cases and reports.
One full period for the whole class to reach a decision that can be submitted to Parliament.
One week completion of reports, summaries and handing in of Assignment.

Materials required

Hypothetical Park and your model of Hypothetical Reef made in Assignment 2.

Each group will require a copy of:

Great Barrier Reef Marine Park Authority Pamphlets:
Introducing Capricornia
Activities Guide
Recreational Fishing
Diving
Great Barrier Reef Marine Park Authority Bulletin February 1986 North West Island
Queensland National Parks and Wildlife Service Pamphlets
North West Island Visitor Information
Capricorn Bunker Islands Camping Guidelines

Pamphlets from the Great Barrier Reef Marine Park Authority on the Zoning Plans on the Capricornia Section of the Reef

What to do:

Part A. Group Work.

Each group discusses each of the following topics and areas of concern. Read the pamphlets and individually answer the following questions. Swap the pamphlets around until you have completed answering all the questions.

Introducing Capricornia Pamphlet
Q1. Draw a map of the area and the General Use zones within it. How many islands are there in the section and how many reefs?
Q2. What is the largest coastal town and how far is it from North West Island and Lady Elliot Island in Nautical Miles.

Q3. If a boat steamed at 5 knotts, how long would it take to get to North West Island? Lady Musgrave Reef?

Q4. Which reefs have been declared:-
(a) A preservation Zone
(b) AScientific Research Zone
(c) A "Look but don't take area"
(d) Prohibited for the collection of shells, corals, and limited recreational fishing

Q5. What percentage of Capricornia is open to general use including commercial fishing and tourist cruise ship regulations?

Activities Guide Pamphlet

Q6. What is the idea behind the activities guide pamphlet?
Q7. What do the terms Seasonal Closure, Replenishment and Reef Appreciation Areas mean?
Q8. Which islands are classified:
(a) Marine National Park "A" Zone
(b) Marine National Park "B" Zone
(c) Scientific Research Zone
(d) Preservation Zone
Q9. Which areas are declared General Use "A" Zones, General Use "B" Zones
Q10. You are planning a trip to Tryon Island. You want to obey the laws of the Park.
(a) Who should you write to and for what purpose?
(b) What limitations would be imposed on you?

Recreational Fishing Pamphlet

Q11. Where is spearfishing allowed in the Capricornia Section?
Q12. Is spearfishing allowed with SCUBA? Why or why not?
Q13. On which islands is a permit required for netting of fish?
Q14. What is an area of periodic restricted use and why is this necessary?
Q15. What are the names of the types of fish that require a permit for collecting?

Diving and Spearfishing Pamphlet

Q16. On what reefs is diving not allowed? Why?
Q17. Is commercial spearfishing allowed in Capricornia? Why or why not?
Q18. What is a *hookah* and is it permitted in Capricornia?
Q19. Who is respoinsible for the day to day management of Capricornia?
Q20. Make a list of any five dangerous marine creatures, make simple line drawings and say why they are dangerous.

Capricorn Bunker Islands Camping Guidelines Pamphlet

Q21. What percentage of the Pisonia grandis forest in Australia is found in the Capricornia/Bunker Group.
Q22. What must be done with rubbish and scraps?
Q23 What types of stoves should be used while camping on Barrier Reef Islands. Why?
Q24. What types of birds nest on the Capricornia/Bunker Goups? What special precautions must be taken with mutton birds.
Q25. List six camping hints that could be observed while camping on Barrier Reef Islands.

Great Barrier Reef Mar. Pk Auth. Bulletin Feb1986 North West Island Pamphlet
National Parks and Wildlife Service Visitor information North West Is Pamphlet

Q26. Write three sentences outlining the important history of North West Island
Q27. What restrictions are there on the use of fires on the island?
Q28. List six suggestions that the National Parks and Wildlife make in the section notes to campers. After each give a possible reason for this suggestion.
Q29. What turtles nest on the islands? What special precautions must be taken when these turtles nest?
Q30. Write six facts about the island vegetation.
Q32. What is a reef appreciation area? Why is it called that and why have one at all?
Q33. How many reef appreciation areas are there on North West Island?
Q34. What are the addresses of the two authorities who manage the reef?
Q35. Draw the symbols that represent the Great Barrier Reef Marine Park Authority, and the National Parks and Wild Life Service.

Part B. Formation of interest groups and preparation of a report for the Authority

The interest groups

Now that you have a knowledge of some of the activities that one or two user groups would have and some of the restrictions that apply in a park such as Capricornia, you are to use a hypothetical reef park to come up with your own zoning plan.

You will need

Copy of Hypothetical Reef Park Proposed Zones and No Zones

To work in a user group. Select one of the following and collect a plan of Hypothetical Reef Park. Your teacher will help you organise the groups and may have a draw for the groups. You may come with groups of your own and use as little or as much of the following information as you desire.

The user groups:- Note * Core groups

The Half Moon Island Development Corporation *
The Newtown Shell Collectors group
The Hypothetical Tourist and Development Corporation
The Scientists from the Newtown University*
The Hypothetical Park Authority**
A Newtown ports fishermans group
The Newtown Society for the preservation of the reef*
The local aboriginal population who have a burial site on Deadmans Island*
The local camping adventurers club
The Newtown commercial fihermans association*
The Newtown waterside workers club

The Hypothetical Park Authority plans are appendixed as are blank plans of the Park. Make sufficient copies of these to assist your group discussion.

You must each submit a separate report based on the combined discussions of the group.

Make clear in your report the following:-
1. What areas you object to and at least two reasons why you object to them.
2. What areas have been completely neglected and why you think they should be zoned.
3. What areas your interest group wants and five good reasons why.
4. What your interest in the park is and why.
5. What association your group has had with the proposed park and for how long.

The group who play the authority's role

You must obtain a copy of the zones, and each person in the group prepare a report as follows:-

1. Clearly make a colour map of the park indicating the zones (use the one attached)
2. Make up an *Activities Guide* like the one for Capricornia. Type or neatly write this up and circulate it to members at the meeting for consideration.
3. Prepare an overhead transparency or big wall chart for the meeting.

Teachers Note: *It is your responsibility to let groups come up with their own ideas, however it may be necesary to seed some ideas into the discussions. Brochures and pamphlets are useful and a model report prepared.*

Editors note: *Future editions of this booklet will have one such simulation.* ***Benmar mining,*** *would be a good example to present because it would seek to mine the reef when in fact we know that mining is impossible at this stage in our reefs. However students who are not used to preparing reports or playing simulation games need some guidance and this example could help.*

Part C: The Meeting

Each group must indicate that it is ready for the meeting. Your teacher will ensure this!

The first lesson. Devoted to the Authority, which explains to the assembled group, its proposed plans. It hands out a pamphlet describing the various uses and restrictions that may apply.

The next lesson. You need a double period and about 15 minutes per group. User groups, why not make signs and placards for your presentation. Better still dress up and really role play the user group as you have seen them depicted in the media. You may like to discuss this with you teacher first and the class next door. You could invite the local press to make it more realistic or a representative from the National Parks and Wildlife Service or Great Barrier Reef Marine Park Authority to act as an observer and then comment on the role play and the accuracy of the roles played.

During the lesson give the people who role play the chance to get their point across. Then try to strike up a debate trying to pick flaws in their arguments. Try at all times to base your arguments on the knowledge that you have gained in this book and reference books, television programmes and newspapers you have read. Make sure you acknowledge these references so that others may judge you on your factual knowledge.

The final lesson

As a class come to some consensus. This must be done because someone has to make a decision sometime.

Use the chart that the authority has to draw in the following zones:-
General Use A
General Use B
Marine National Park A Zone
Marine National Park B Zone
Scientific Research Zone
Preservation Zone

Handing in of the Assignment

Your teacher will outline what is required. Essentially it could be organised as follows:

Part A: Answers to the 35 questions

Part B: The report.

The answers to the questions as outlined above
The proposed zoning plan that the whole class has come up with and the reasons why (for submission to Parliament).

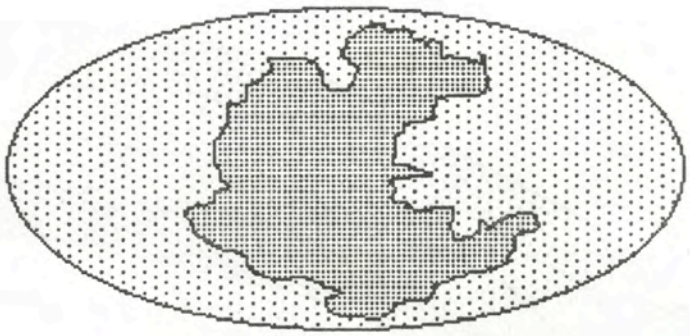
Concluding remarks.

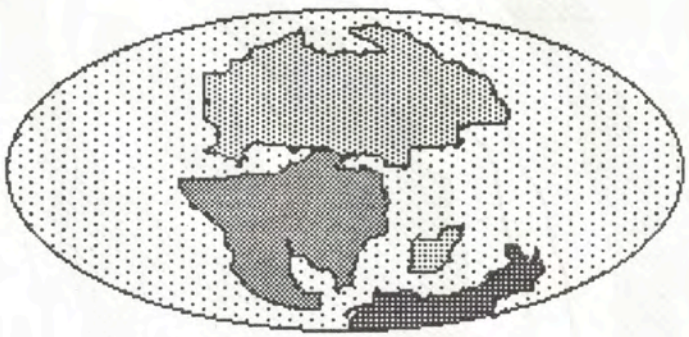
To the students and teachers who use this booklet:

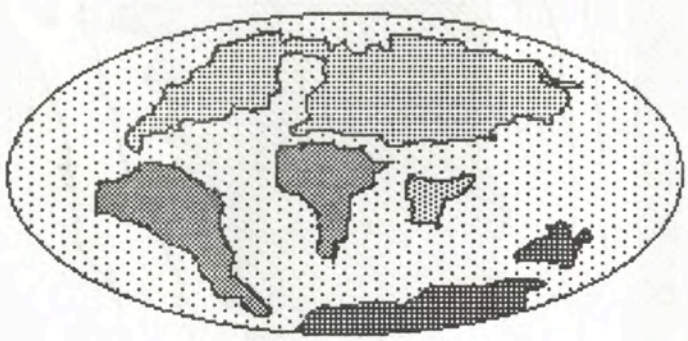
The management of the Reef is up to you. We hope the knowledge and skills you have aquired will assist you to make responsible, and more importantly, informed decisions. In 200 years the Reef could be mined and there could be oil rigs or some underground mining. Governments across the world change and so do the attitudes of people from one generation to the next.

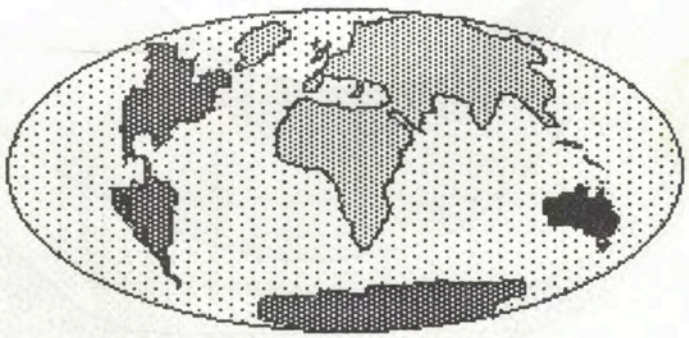
Make sure your generation makes informed decisions and judges the reef for what it really is - one of the world's greatest living things to be loved, admired and used by all wisely for all times.

Wet Paper Publications July 1987

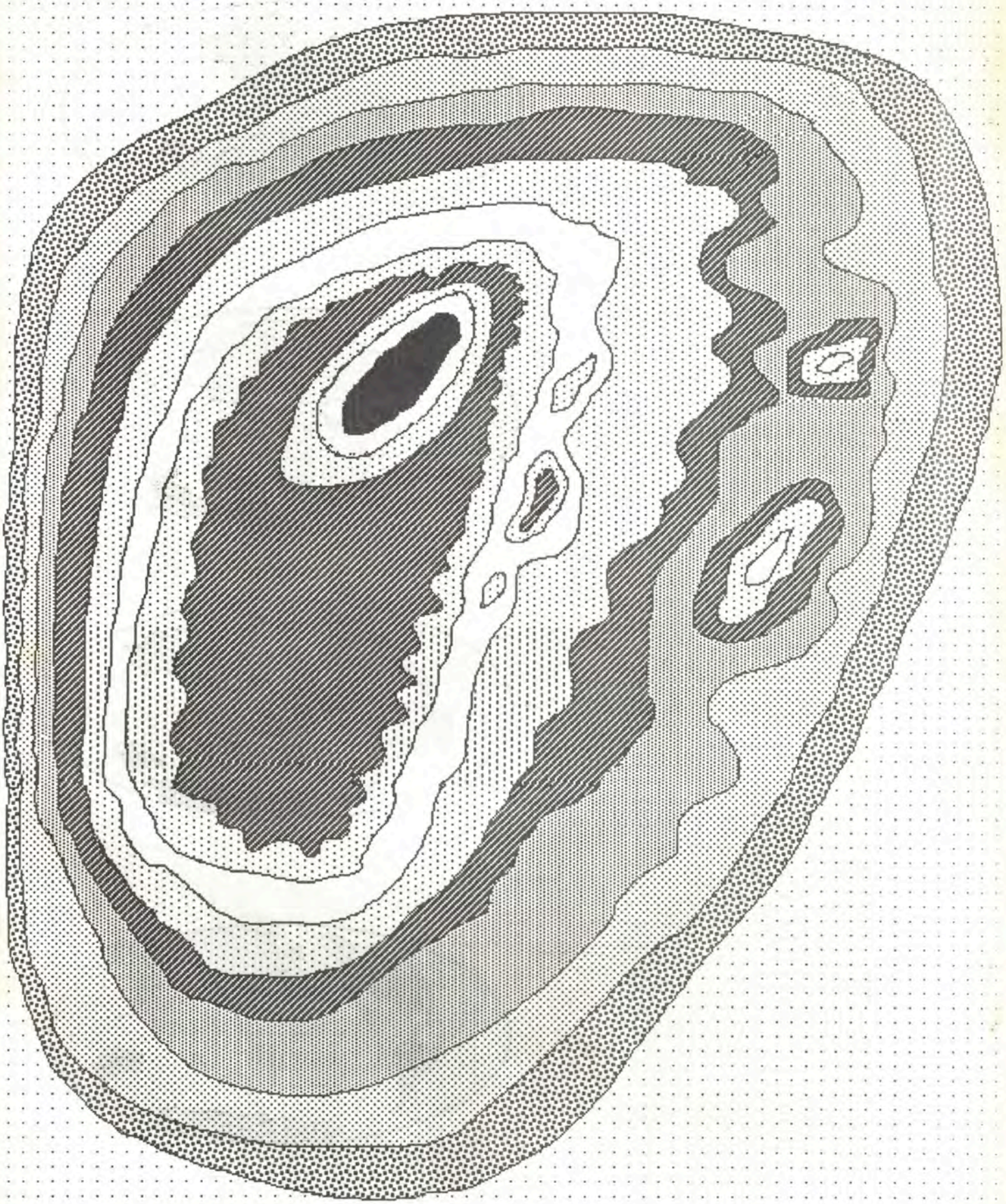


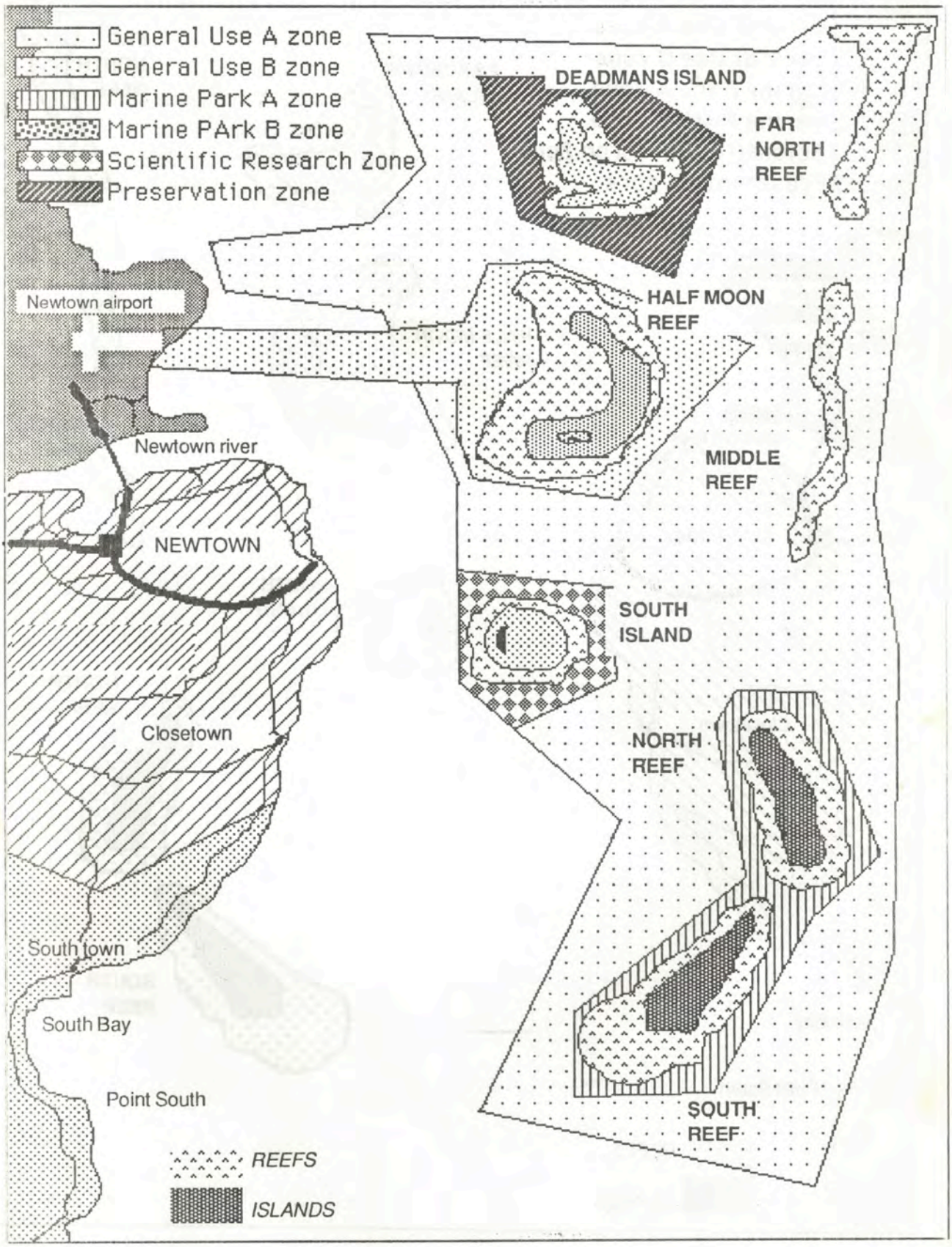


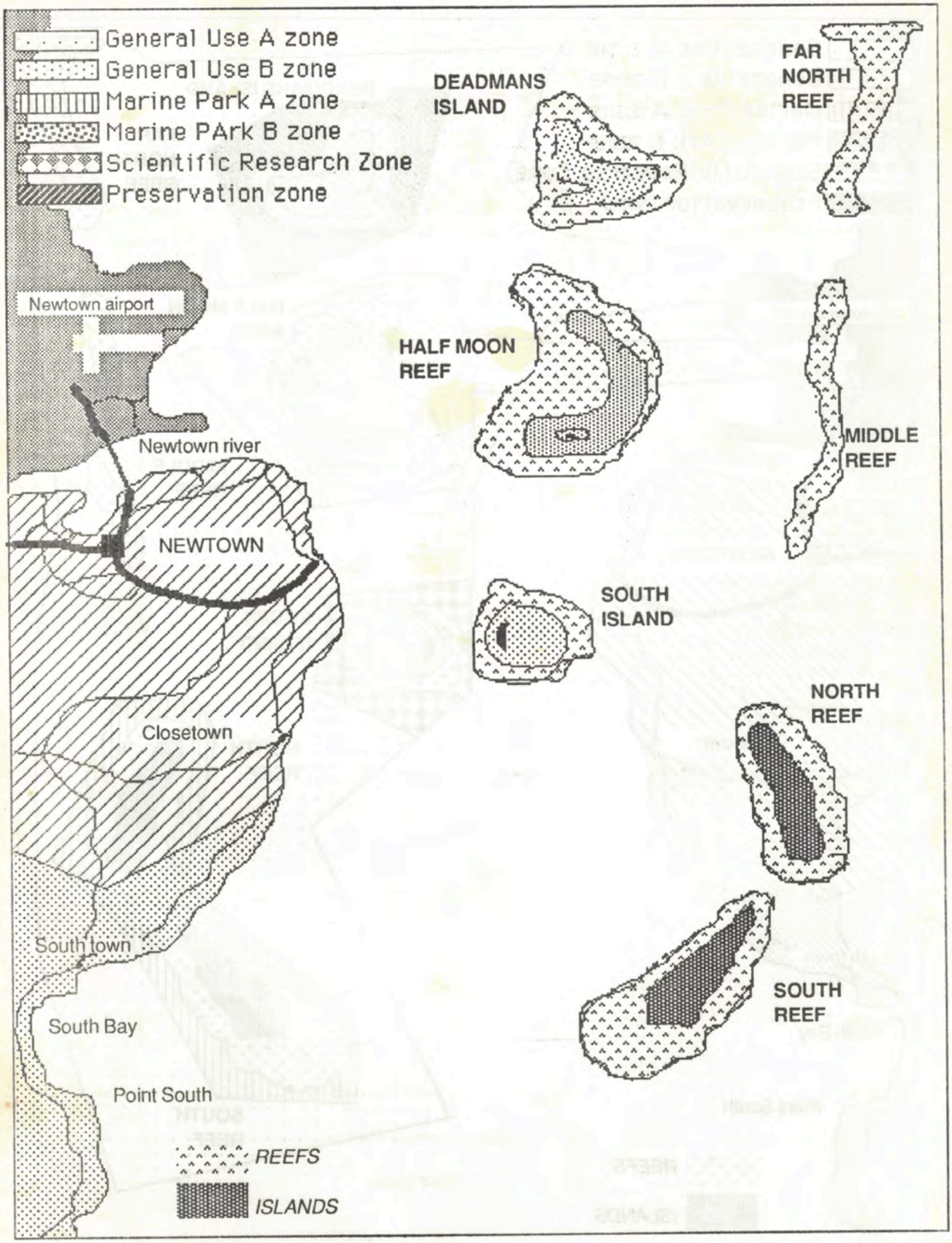




APPENDIX ASSIGNMENT 2 WORKSHEET HYPOTHETICAL REEF




General Use A zone
General Use B zone
Marine Park A zone
Marine PArk B zone
Scientific Research Zone
Preservation zone
DEADMANS ISLAND
FAR NORTH REEF
Newtown airport
HALF MOON REEF
Newtown river
MIDDLE REEF
NEWTOWN
SOUTH ISLAND
Closetown
NORTH REEF
South town
South Bay
Point South
SOUTH REEF
REEFS
ISLANDS



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