CHANNEL ISLAND - A NATIONAL HERITAGE SITE

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INTRODUCTION

This unit introduces students to the various features of Channel Island which is located in Middle Arm of Darwin Harbour, about 10 km south of Darwin. This island is a familiar landmark in the region, and although small in area it is of special interest for two reasons.

Firstly, its natural environment includes a dense mangrove community fringing three sides of the island and a well-developed coral reef between the east side of the island and the mainland. Both are of ecological importance and even by themselves would make Channel .Island a significant heritage site.

This unit "vill present some examples of how the ecosystems on Channel Island are related to other elements of the natural environment such as climate, tides and landforms. The text and accompanying illustrations, along with the suggested activities has been designed to develop an understanding of the nature of the mangrove and coral reef communities. You will have the opportunity to examine data that demonstrates how the mangroves and reef form a significant part of Darwin Harbour's marine environment.

Secondly, although the island has been used for a number of purposes over the years, it is most remembered as a, leprosarium - a place where patients suffering from the disease of leprosy were kept in compulsory isolation. As most of the patients were Aboriginal people, the island is linked not only with developments in medical knowledge but ""ith the evolution of government policies in the area of Aboriginal health care.

The main historic events associated with the island are outlined in the text. The story of Channel Island will introduce readers to the idea that human behaviour is often based on a range of culturally constructed values. Activities centred on the island's history will give students an opportunity to develop fresh perceptions of time especially when it applies to comparatively recent events.

Individual and group activities which range from in classroom to extramural are included at the end of each section. Resources that will be of help in following this unit are also listed where appropriate.

Chapter 1: CHANNEL ISLAND CORAL REEF'

The reef on the eastern side of Channel Island lies between the mainland and the island and is visible from the bridge to the island. It consists of a shallow rock shelf upon which many small colonies occur. The coral, however, is not built upon dead coral as happens in larger reefs such as barrier reefs or coral atolls but on rock. The extreme tidal range (the difference between high and low tides) of Darwin Harbour creates strong currents which have scoured the coral rubble off the reef into deeper water at either end. The top of the reef is flat, creating an irregular shallow lagoon. It may dry out at extremely low tides which occur only a few times in a year.

HARD OR STONY CORALS

The water in Darwin Harbour has a high turbidity and is very murky. This restricts the growth of corals from the shallow water at the lowest tide levels down to about 3 m. Corals need to have clear water because they depend on sunlight to live. Although coral is a colony of small cylindrical animals (polyps), each polyp contains small granules of algae, a plant group which also includes seaweed, microscopic single-celled plants in plankton and the green film on the sides of fish tanks.

The algae, like all plants, are capable of photosynthesis. They convert the polyp's waste into proteins. They also use the polyp's carbon dioxide (plus seawater) to convert the sun's energy into carbohydrates. These in tum give the polyp not only enough energy to carry out the functions of life but to also build a limestone wall around itself using calcium from the seawater. As a final bonus, the algae produce oxygen from their photosynthesis which is exactly what the polyp needs so that it can breathe. The whole process is breathtakingly efficient, simple in principle yet complex in operation. This system has functioned in various locations for the last 200 million years. Given that ocean waters are kept clear and unpolluted, corals may continue to live and grow into the indefinite future.

The driving force behind a coral colony's growth is the polyp's ability to produce exact copies of itself that remain connected to each other in the same colony. In the process of dividing or budding, the mouth of the polyp moves to one side ofthe animal and a new mouth develops alongside the old one. The animal then divides into two new polyps. Sometimes three mouths are formed in the process. The genetic blueprint of the polyps controls the manner in which they divide and grow, so that the colonies of each species produce the same limestone forms (e.g. plates, staghorns) and patterned surfaces, so that it is possible to identify a species of coral by its appearance.

It is this diversity of shapes, patterns and textures displayed not only by corals but by all types of marine animals that makes a coral reef one of nature's most impressive spectacles.

THE CORAL REEF HABITAT

If an object such as a car wreck is dropped into the sea it quickly becomes colonised by a variety of organisms. Sea mosses (bryozoans), which are plant-like animals, coat its hard surface along with a variety of seaweeds. Sea lilies, bristle worms, mussels and sea stars take up residence, assured of a food supply made up of the larvae and eggs released into the water by the other animals. The young life forms drift in the sea as part of the plankton, a floating soup that is a source of energy to the whole ecosystem. The plankton also includes single-celled algae (phytoplankton) and the adult forms of microscopic animals (zooplankton).

Small crabs and fishes find shelter in the car body and feed on the algae and other organic material that gathers there (animal remains, minute crustaceans). Sponges and sea anemones grow on parts of the wreck, and an octopus or a moray eel finds an ideal home in the cave like interior.

Attracted by this variety of life many larger fish gather at the scene. Some are bottom feeders, munching on shellfish and crustaceans whilst others, the predators of the sea, hunt for the smaller fish that have made this their habitat.

Consider the implications of our car wreck scenario. Like a natural reef it offers two things, shelter and food. Compared to the life that develops around a car or boat wreck, imagine the rich variety of marine life that can become established on a natural reef oVefthousands of years.

There are other features of the reef besides biological diversity alone. Because of the great variety of life forms and marine species, many reef organisms have evolved to fit into specialised niches which may involve interesting associations with other plants and animals.

Empty mollusc shells are used as shelters for hermit crabs, and anemones may grow on the outside of the shells. Another association is that of the clov.'I1fishor anemonefish which live amongst the tentacles of sea anemones. The tentacle stings would kill other species of fish but the clownfish has built up a resistance to the poison. Different species of anemonefish have preferences for different species of anemones. The fish gain protection from enemies and the anemone feeds on food scraps dropped by the fish. Some species of shrimp have cleaning stations in the coral crevices. They advertise their services by waving red and white antennae and pick external parasites off the fish who line up at the station.

Like all ecosystems, the coral reef depends upon plants to produce food for energy which ,\-ill be passed on through the system. The variety of life on a reef means that there are many complex food webs in which animals have developed a corresponding variety of food-gathering strategies. Because the water in which marine organisms live contains an abundance of food, many animals anchor themselves to the one spot and filter food from the seawater as it passes through their bodies. Filter feeders include sponges and some species of molluscs (e.g. oysters, mussels). The sea anemones, stony corals, soft corals, gorgonians (sea fans) and jellyfish are suspension feeders, taking zooplankton and minute crustaceans that are drifting suspended in the current.

Many of the predators have specialised food sources and this is reflected in the variety of mouthparts that can be observed amongst fish. Butterflyfish have a long tube with a tiny mouth at the end suitable for probing amongst the coral crevices for living polyps, algae, worms and coral mucus. Along with a number of other fish species, coral trout have mouthparts that can be slung forwards to engulf prey. Bottom dwelling snapper have powerful jaws that can crush small molluscs and crustaceans. The poisonous pufferfish have bony mouthparts used to crunch sea urchins whilst the parrotfish use their beak-like mouths to bite chunks off the coral for the algae it harbours. The whole reef resembles a busy workshop with numerous skilled workers going about their occupations equipped with their different tools of trade.

ACTIVITIES

Activity 1. Diversity of Shape and Pattern

As an out-of-school assignment, visit your nearest shoreline (e.g. Lee Point in Darwin) and collect a representative sampling of coral fragments that have been washed up on the beach. Make two sets of drawings, one showing the variety of shapes that you collect (e.g. plates, branched corals, spheres) and the other the variety of patterns on the surface of the coral. You might like to work in pairs on this activity.

When the results of your coral survey are displayed, discuss the main purpose of this activity. Was it to give a practical example of what is meant by diversity, or to show that coral species can be identified by shape and pattern, or to demonstrate nature's endless ability to produce visually pleasing forms and textures or a combination of all of these objectives?

For students in schools that aren't c!ose to the sea, substitute graphic images for the real coral pieces. Scan pictures of coral in books, videos, magazines and posters to create your display sheets. You will need to be selective and to observe the images closely.

Activity 2. Classifying Animals

The text has mentioned a variety of marine organisms, each of which belongs to a major group (phylum or class). Again working in small teams, prepare a number of pages on which are drawn boxes for each group (say a half a page per group) and label them as follows:

SPONGES CRUSTACEANS CNIDARIANS ECHINODERMS

BRYOZOANS FISHES MOLLUSCS

List all the organisms' names that appear in the previous pages and using various reference books find out to which group each one belongs. Place the names of the animals in their correct boxes and draw an identifying sketch alongside each name. Sometimes two sketches may be needed for the one animal type because of its variety of shapes in its group e.g. stony corals. Some boxes will be filled with different sub-groups; others will have no important sub-groups e.g. sea mosses or bryozoans.

The cnidarians or stingers (animals with sack-like bodies and radial symmetry) were once called coelenterates and some books may still use this name.

Tidy up the sheets' layouts and file them in a ring binder. Your team now has a reference for the grouping of marine animals and it can be used when visiting aquariums or viewing videos about coral reefs. It can be added on to (the groups called segmented worms have not yet been mentioned) and illustrations and cuttings can be inserted where, necessary. You will need to refer to it when reading the next section on zonation of the Channel Island Reef.

Activity 3. Familiarisation

Visit Indo Pacific Marine on Stokes Hill Wharf in Darwin. Your main focus should be in discovering how a coral community can function as a self-contained ecosystem with little other input other than strong light. Familiarise yourself with the names and identifying features of some of the main marine organisms. Your teacher may want you to summarise the animals you see in table form (name, group of animals to which it belongs, habitat, role in ecosystem). Most of all, enjoy the spectacle.

If unable to make the visit, view a video which shows life on a cora! reef and discuss the main focus (suggested above) after viewing.

For individual viewing, there is a CD-ROM entitled Barrier Reef, produced by Webster Publishing, Frenchs Forest, NSW.

Activity 4. Fish Mouthparts.

Working in teams, create a poster by collecting pictures (photocopies or drawings) of the fish mentioned in the text. Print in information about their mouthparts and food sources. Add other examples of marine food-gathering adaptations that you may find.

Activity 5. Individual Essay

The tropical rainforest, the place on land where life proliferates at its most diverse and dense, has its marine equivalent in the coral reef (Attenborough, 1984)

Write an essay explaining why Attenborough made this comment. What are the visual and ecological similarities between rainforests and coral reefs? Where does the similarity end and what are some significant differences?

ZONATION OF THE CHANNEL ISLAND REEF

The top of the reef which may be exposed at exceptionally low tides supports a number of species of hard corals, many algae and prostrate sponges. Barnacles grow on higher outcrops of rock and small fish (gobies) and shrimps live in rock pools on the reef shelf. The corals include mushroom corals *(Fungia* spp.), large domes of brain corals *(Favites* spp.), smaller honeycomb corals *(Goniopora* spp.), and staghorn coral *(Acropora* spp.) As well as hard corals, soft corals also live in this area.

On the slopes of the reef, heads of *Favites* are common and large plate corals dominate the zone from 0.5 m to 3.0 m. The plate corals are close relatives of the staghorn corals even though their outward appearance differs. At greater depth the plate corals give way to elegantly branching gorgonians, sponges and bryozoans.

At the base of the reef, fan and lyre gorgonians grow along with sea whips, sponges and bryozoans. Crinoids (feather stars) and sea cucumbers also live on the gravel and stone seabed along \vith many species of polychaete (segmented) worms. Some polychaete worms (fan worms) have their bodies protected by a long tube built into coral or rock. A ring of brightly coloured tentacles protruding from the tube is all that can be seen of the creature. Other polychaete worms do not live in tubes fixed in the one place (sedentary) but are free wandering. One such worm is the scale worm *(Lepidonotus* sp.) that lives at the base of the reef under rubble and is an active carnivore, seeking out and seizing small prey.

Crustaceans include small porcelain crabs that make their homes on living coral, and the well camouflaged crab *(Pilumnus* sp.) that is almost impossible to see amongst the brown seaweed. Snapping shrimps, mantis shrimps and spider crabs have also been observed on the Channel Island reef. One small crab, the hairy coral crab *(Cymo* spp.), will only live with certain types of coral including the staghorn coral described above. Blue swimmer crabs *(Portunus pelagic us)* are found in the area.

FISHES

Fishes make use of the reef as a shelter and a food resource in a variety of ways. Some species usually the smaller ones live amongst the coral formations whilst others of larger size patrol the reef edge at various levels. The largest predators (e.g. trevally) have wider hunting grounds that include both island perimeter and waters ofthe mid-estuary channels.

The most common fish of the reef are gobies and over 20 species have been recorded from the locality. These small fish live under rocks or in deep holes which are dug in the sediment of the sea floor near. Their food varies according to the species and may include algae, zooplankton, wornlS and small crustaceans. Another small fish that is present in large numbers are hardyheads which swim around the reef in schools searching for small crustaceans.

The table below gives information about other fishes of the Channel Island reef.

NAME	SIZE	HABITAT	FOOD
Silverbiddv	200mm	sandy seabed	crustaceans, worms
eardinalfish *(Apogon* sp.)	120mm	under ledges	small shrimps
Coralfish *(Chelmon* sp.)	160mm	amongst coral	small invertebrates
Pipefish	200mm	amongstseavveeds	tiny crustaceans
Anchovy	70mm	schools on outer reef edge	plankton. small algae
Batfish	500mm	reef edges	ommvorous
Bluetooth tuskfish	700mm	reef ledges and bottom	molluscs, crabs
Angelfish *(Centropyge* sp.)	180mm	amongst coral	onmlvorous
Butterflyfish *(Chaetodon* sp.)	180mm	amongst coral	coral polyps, worms
Coralcod	450mm	reef waters 5-10 m deep	fishes, crustaceans
Javelinfish *(Pomadasys* sp.)	450mm	outer reef edges	crustaceans
Russell snapper	500mm	reef edges and seabed	fishes,crustaceans
Pufferfish *(Torquoener* sp.)	100mm	rock and coral reefs	omnIVorous

Source: Draft Environmental Impact Statement for Channel Island. Note that the size is for an estimated average adult's size. Omnivorous fishes shown above include both algae (seaweed) and small invertebrates in their diet.

ACTIVITIES

Activity 6. Zonation

Your team can interpret the above information in graphic form. Construct two diagrams of the reef in cross-section showing the vertical zones of the reef and the creatures associated with each zone. Use symbols to indicate the location of the corals and other organisms mentioned the parts of the reef favoured by the various fish species.

Symbols can be repeated e.g. plate corals occur at intervals down the sides of the reef, so more than one plate symbol can be used. Don't forget to show a key to the symbols you use. Note that this activity may lead to some further research such as what is a sea whip and what does it look like?

Activity 7. Classifying Animals

Update your team's file on reef organisms by adding any new animals mentioned above. Bennett (1992) has a chapter on polychaete worms.

Your class may care to discuss the outcome of this activity. The data you have collectively gathered could be a handy reference for other students, possibly in other schools. Discuss how best to collate, store and present it: whether to establish a computer database or to present the data in printed form.

Activity 8. Fishes

Discuss probable food chains that may result from the activities of some of the fish species named above. Note that food chains will start from either single-celled algae floating in the plankton, algae contained within the bodies of coral polyps, seagrass, minute algae forming a film on hard surfaces, seaweeds or mangroves.

Discuss the various ways that the fishes of the reef could be classified. What different criteria can you think of (e.g. sorting according to size, grouping by importance as a human food resource)?

Carry out the process of classification. Make lists of the species within the groups for each of the criteria you have decided upon and record your lists on a large sheet of butcher's paper. What do you notice after various sorting exercises? Do clusters of fish species tend to stay together, or do they shift about to form new sets of species, according to the criteria?

.What principle or general rule of nature can be deduced from this activity? Does it
.demonstrate that each species is difficult to separate from others no matter what criteria are used, or does it show that each species has a unique set of attributes that sets it aside from all others? Within the one ecosystem, does biodiversity involve a wide range of roles for animals of the same general type (or class) or is there considerable duplication of structure and function?

Activity 9. Design and Artwork

Create a design for a piece of artwork using elements of reef and marine life as a source of inspiration. The finished work can be for a mural, an environmental protection poster, the title piece for a CD-ROM on coral reefs or for a T-shirt.

Discuss what can be done with the finished works: hold an exhibition, actually paint a mural or select the most attractive design for a T-shirt and have it colour copied onto a garment.

Activity 10. Coral Reefs

There is a considerable difference between the reef of Channel Island and other larger reef formations such as the Great Barrier Reef. To help you become familiar with some of the terminology associated with coral reefs research the subject in teams. Have your team prepare a report on the formation and development of barrier reefs, fringing reefs and atolls, complete with diagrams. Note that the reef at Channel Island does not fall into any of the above categories. Such reefs as that at Channel Island are localised communities of coral which attach themselves to shallow rock shelf formations of a relatively small size.

Activity 11. Conservation-Team Research and Evaluation (Major Assignment)

The point of this whole unit is to examine the importance of Channel Island as part of the National Estate. It is of little use to declare an area as having heritage value if adequate steps are not taken to preserve it for future generations, and at this stage your class could start to collect data about the conservation of the marine environment of Channel Island.

Your team's task at this stage is to research possible environmental threats to marine life in Darwin Harbour and ways in which the marine environment is protected discover what steps are being taken by various levels of government to preserve the ecological integrity of the coral reef and mangrove ecosystems of Channel Island inquire about what planning (or legislation) is in place to lessen the impact of future works and housing projects on the mangroves of Darwin Harbour.

The next section of this unit is the investigation of the mangrove communities of Channel Island. As they are part of the same estuarine system as the reef and subject to the same influences of tides, currents and seasonal change, conservation issues will apply equally to both ecosystems.

At the end of the mangrove section, you will have had time to research the topic of conservation in the Darwin Harbour region (letter-writing, interviewing, faxing, reading, phoning). Your team will then be able to discuss the effectiveness of management action plans and conservation measures that currently affect the heritage value of Channel Island.

For information on beneficial uses for Darwin Harbour:

Water Resources Division Power and Water Authority GPO Box 1096 DARWIN Tel.247 232Fax410 703

Protection of harbour waters:

Environment Protection Division Department of Lands Planning and Environment GPO Box 1680 DARWIN Te1.244140 Fax. 244053

Conservation, general:

Heritage Conservation Unit Lands Division Department of Lands, Planning and the Environment (address as above)

Future foreshore planning :

Land Development Section Lands Division Department of Lands Planning and Environment (address as above)

Environmental protection of the seaways:

Marine Environment Protection Services Australian Maritime Safety Authority PO Box 1108 BELCONNEN ACT 2616Te1.06279 5935 Fax. 062795076

Contact Darwin City Council and Palmerston Town Council for information on marine environmental protection policies.