



# Module 3: Estuaries



# Estuaries in Marine Parks

An estuary is a unique environment where flowing fresh water from a river or creek meets the salty seawater, creating a brackish region of mixed water. Being so close to the sea, the estuary is subjected to the daily fluctuations of the tide. The combination of the sheltered area, lack of wave energy and fine soft sediment creates a very special habitat where highly specialised plants have become adept at living. Three highly productive estuarine vegetation communities are particularly important: mangroves, saltmarsh and seagrass.

## Mangroves

Mangroves are found mostly in sheltered estuarine environments, growing primarily on areas of soft sediment, which form a distinct habitat known as a “mangrove forest”. Mangrove trees are well adapted to changes in salt levels, and have developed exceptional ways of dealing with the estuarine environment.

There are seven species of mangrove in NSW, of which the grey mangrove is the most common. Possibly the easiest to recognise, it has long thin roots (known as pneumatophores) that rise vertically up through the mud. Since the mud is so thick that oxygen cannot get much deeper than the first couple of centimetres, these roots act like snorkels. To get to oxygen, the mangrove sends the roots up above the mud and respire oxygen through little holes on the pneumatophores, which then store oxygen in the plant during high tide.

Mangroves play a very important role for many of the animals that live in estuaries. The pneumatophores, root systems and fallen branches create a nursery habitat for juvenile prawns and fishes, such as bream, mullet, whiting and luderick. The trunks and roots also provide a home to oysters, barnacles and limpets, as well as an array of seaweeds and lichens for animals to graze on. In the branches of the mangroves it is often possible to find some beautiful birds such as the mangrove gerygone (a mangrove specialist), the sacred kingfisher and various honeyeaters which come to enjoy the sweet mangrove blossoms.

L-R: Grey mangrove (*Avicennia marina*) and river mangrove (*Aegiceras corniculatum*)



## Saltmarsh

Saltmarsh consists of a diverse range of grasses, saltbushes, rushes and sedges, and is found in the upper intertidal area of the shoreline in estuaries. The plants making up saltmarsh differ from one area to another. In NSW, 25 different plant compositions have been identified along the central NSW coast alone. Saltmarsh in southern NSW is generally more species-rich than in northern NSW.

Saltmarsh improves breeding in fisheries by providing shelter, a feeding ground and a general nursery area for juvenile fishes, similar to the way that mangroves also provide a nursery habitat. Many animals use saltmarsh as feeding grounds. Fishes and crabs feed in saltmarsh during king and spring tides, and shorebirds often feed at low tide.



Saltmarsh supplies a large amount of decaying organic material into food chains in estuaries. Bacteria and scavengers, such as crabs, break down the organic material (known as “detritus”) into nutrients, which in turn becomes food for fish, crabs and other crustaceans, shellfish, and then larger animals. Saltmarsh is also very important for controlling floods and erosion, and for filtering pollution. In NSW, saltmarsh is a threatened community, with only a fraction of its original area still remaining.

## Seagrass

Seagrasses are unique marine plants that grow in nearshore environments, estuaries and sheltered bays. Seagrasses, like their terrestrial grass cousins, are anchored to the sea floor by roots or “rhizomes”, and have leaves with veins. They also reproduce using flowers and seeds, and require sunlight to grow.

Seagrass beds are found in many marine park estuaries and are another very important habitat for a range of marine life. Fish, prawns and swimmer crabs are often spotted hiding and feeding amongst the seagrass. Seagrass also assists in sediment stabilisation, where it helps to reduce erosion. There are six species of seagrass found in NSW waters, but the most common are *Zostera capricorni* (bottom left), *Halophila ovalis* (bottom right) and *Posidonia australis*.



Estuarine seagrass supports many coastal fisheries by providing an important area for juvenile and adult fish to hide, eat and breed in. Approximately 70% of commercially and recreationally important fish species in NSW rely on estuaries and their seagrass habitats at some stage in their life cycle.

### Management of estuaries

There are several different types of estuaries, such as drowned river valleys, barrier estuaries, which are mostly open to the tide, and coastal lagoons, which are intermittently closed and open to the tide (known as Intermittently Closed and Open Lakes and Lagoons or ICOLLs).

The importance of such estuarine systems means that they have been included in NSW marine parks. Of the 133 major estuaries in NSW, approximately 50 estuaries are included in NSW marine parks.



**Industry & Investment**

Industry and Investment NSW has management responsibilities for mangroves and seagrasses, which are protected through the *Fisheries Management Act 1994*. The Department of Environment, Climate Change and Water manages saltmarsh, which is an endangered ecological community.



**Environment, Climate Change & Water**

### Popular activities in NSW marine park estuaries

Estuaries provide a perfect place for recreational activities with their sheltered waters, productive habitats and extensive waterways. Boating, swimming, recreational fishing and collecting are very popular activities. Some estuaries are also very important for aquaculture, with oyster aquaculture present in most tidal estuaries. Commercial tour operators provide opportunities for dolphin watching and fishing, and hire businesses supply boats, kayaks and other equipment for recreational enjoyment.



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# Estuaries of the Lord Howe Island Marine Park



Lord Howe Island (above) is a small, crescent-shaped island of volcanic origin. It has an unusual shape and size, and contains only three small estuaries, all of which flow into the relatively sheltered waters of the lagoon, one of the Island's most significant features.

The three estuaries are all semi-permanent, are intermittently closed to the lagoon, and have small catchment areas. Soldiers Creek is the largest estuary, and is often flushed by tidal inundation, but can be closed to the lagoon during summer. Cobby's Creek (bottom left) and Old Settlement Creek are small creeks that are only open to salt water as little as once a year, and so they remain almost permanently brackish. How often these small estuaries are open to the lagoon is partly dependent on coastal drift processes which affect the way that sand is eroded or deposited near the mouth of the estuary. Despite the small size of the estuaries, they still contain highly productive estuarine vegetation, including two species of mangrove – the grey mangrove and the river mangrove – and small stands of saltmarsh, consisting of grasses, rushes and sedges. These important areas are protected within habitat protection zones of the Lord Howe Island Marine Park.



The lagoon, on the western side of the Island, has international significance as it contains the world's southernmost true coral reef (bottom right), and is the only fringing coral reef lagoon in NSW. The lagoon is less than 10 metres deep, and includes shallow reef platforms, gravel sheets, trenches and isolated depressions (or "lagoon holes"), and scattered patch reef. The nearby fringing reef shelters the lagoon from ocean waves, creating this unique environment where coral, seaweed and seagrass communities are found close together – a distinctive feature of Lord Howe Island Marine Park.



Lagoon reefs at Lord Howe Island are situated along a six-kilometre-long, discontinuous fringing reef enclosing a shallow lagoon that is up to two kilometres wide. The living structure of the reef provides protection from ocean waves, and gives shelter to the reefs and associated species within the lagoon. Reef habitats within the lagoon are usually either coral or seaweed-dominated, and are different to those found on the wave-exposed coastlines of the marine park. Coral habitats in the lagoon are typically tropical reefs, with common corals in the lagoon including the columnar (*Porites* spp.) and staghorn variety (*Acropora* spp.), and a high abundance of delicate plate or branching species. Soft corals are also present at most lagoon reef sites. The reefs that contain a high abundance of seaweeds have a high number of urchin species and warm temperate fish species, particularly herbivorous types such as bluefish.

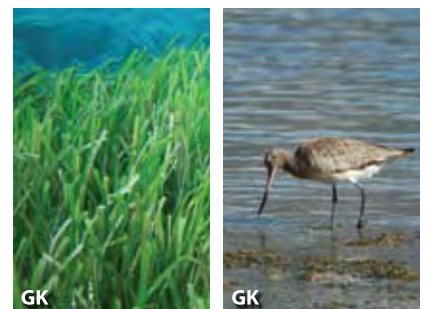
The lagoon contains two species of seagrass – eelgrass (right) and paddle weed – with the most extensive seagrass beds found in Hunter and North Bays at the northern end of the lagoon. These seagrass beds provide an important habitat for a range of invertebrates, such as molluscs, crabs, shrimps, polychaete worms and the prickly razor clam. Seagrass beds are also important nursery grounds for juvenile fishes. For example, the eastern sea garfish uses it as a breeding ground, and the endemic pygmy seahorse has only been found in seagrass near Erscotts Hole. Migratory shore birds, such as northern hemisphere species of whimbrel, bar-tailed godwits (far right), ruddy turnstones, Pacific golden plovers and grey-tailed tattlers, forage in the intertidal seagrass flats during summer, with New Zealand double-banded plovers appearing during winter. Local populations of hawksbill and green turtles (right) utilise seagrass beds in the lagoon as a feeding and resting area, and are commonly seen amongst the seagrass and reef habitat of Hunter Bay and North Bay.

Over 148 fish species and 43 invertebrate species have been identified in the lagoon habitats, with many other plants and animals also living amongst these diverse and productive systems.

The lagoon contains three “observe and conserve” sanctuary zones – North Bay, Sylphs Hole (right) and the Lagoon sanctuary zones – areas where all flora and fauna are protected. Snorkelling, diving and swimming are all popular activities that can be undertaken within the sanctuary zones. The rest of the lagoon is protected in habitat protection zones, where additional popular recreational activities such as recreational fishing can occur. Very small areas of the lagoon are designated as a special purpose zone to allow for limited fish feeding, a popular activity for visitors which is undertaken by permitted marine tour operators, under strict guidelines, to minimise any impacts on the unique lagoon environment.



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# Estuarine Organisms of the Lord Howe Island Marine Park



**Sacred kingfisher**  
(*Todiramphus sanctus*)  
A striking blue and black bird that feeds in a variety of habitats on small fish, grubs and crickets.



**Bar-tailed godwit**  
(*Limosa lapponica*)  
This bird feeds on insects and worms and has one of the longest migrations of all birds: 7000km in nine days.



**King prawn**  
(*Haematopus fuliginosus*)  
The king prawn has a bright blue tip on its tail fans. The juveniles live in estuaries.



**Hawksbill turtle**  
(*Eretmochelys imbricata*)  
These smaller-sized turtles eat sponges, algae, jellyfish and seashells.



**Mud crab**  
(*Scylla serata*)  
The mud crab has a wide distribution, and is a large crustacean that can stand harsh environments.



**Mudwhelk**  
(*Pyrazus ebeninus*)  
Large snails that filter food from the mud, these animals are eaten by birds, octopuses and stingrays.



**Soft coral**  
(*Dendronephthya* sp.)  
Although soft-bodied, this coral holds itself upright by pumping water through its body.



**Urchin**  
(*Heliocidaris tuberculata*)  
This urchin feeds on algae and lives in coral and seagrass areas.



**Grey mangrove**  
(*Avicennia marina*)  
The grey mangrove breathes through peg roots (pneumatophores).



**River mangrove**  
(*Aegiceras corniculatum*)  
A common species, this mangrove has glands on its leaves that secrete salt.



**Paddle weed**  
(*Halophila ovalis*)  
A round-leaved, flowering plant, this seagrass is a favourite food for sea turtles.



**Eelgrass**  
(*Zostera muelleri capricorni*)  
The most common species of seagrass, eelgrass has a long, narrow leaf.



**Whiting**  
(*Sillago ciliata*)  
Found in bays, estuaries and beyond the breakers off surf beaches, whiting can grow to 50cm long.



**Sand mullet**  
(*Mugil elongatus*)  
Mullet feed by vacuum-cleaning the mud with soft lips that filter out food.



**Long-finned eel**  
(*Anguilla reinhardtii*)  
A large, primarily carnivorous fish that has a broad head.



**Bluefish**  
(*Girella cyanea*)  
This fish is bright blue with small yellow spots. A limit of five fish only can be taken at one time at Lord Howe Island.

Fish images by Richard Taffs, NSW Industry and Investment.

# Stage 1 - Local Places

## Teacher Activity Plan

### Level

Stage 1 - Local Places  
COG Group A - Exploring Our Place

### Key Learning Areas

ENS1.5, ENS1.6 and DMS1.2

### Objectives

The objectives of this activity are: to gather information about the natural estuarine environment; and to increase the understanding of relationships between animals, their environment and humans.

### Excursion Timing

The excursion must be undertaken at low tide. Check the tide times at:

<http://www.bom.gov.au/oceanography/tides>

### Equipment Used

- coloured pencils
- scissors
- A3 paper

### Teacher Resources

Please contact the marine park office on 6563 2359 for a copy of all educational material on CD or to request staff attendance for excursion support. Additional resources are available on:

<http://www.mesa.edu.au>

Link to habitat mapping fact sheet on saltmarsh and estuaries:

[http://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0020/236234/mangroves.pdf](http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/236234/mangroves.pdf)

### About this program

This module is designed to cover ENS1.5, ENS1.6 and DMS1.2, and when combined with the other three modules in this kit, addresses the key learning areas for COG Group A, Stage 1 - Local Places. Follow up this module with the Marine Parks, Rocky Shores and Sea Country modules for further insight into the local environment. The modules are designed to address the NSW DET primary school curriculum, and can be used to complement current teaching programs.

Education material in this module consists of this **Activity Plan** to guide teachers through an excursion, a **Fact Sheet** to provide background information on estuaries, and an **ID Guide** for both teachers and students to identify the most common animals and plants found in estuaries.

### Program outline

This program introduces some estuarine plants and animals, and provides information on where they live, and how they interact with each other, their environment and humans.

### Activity 1

Using the fact sheets, explain the significance of mangroves in estuaries. Copy the activity sheets at A3 size and use the mangrove tree as a base for developing the estuary food chain. Students then, either individually or in small groups, colour the animals, cut them out and construct the food chain below the mangrove tree using arrows to link the chain together (see the example on p.60). The animals should be represented on the diagram in their preferred habitat. Illustrate the page further with other animals that live in the estuary, such as crabs in the mud, insects in the trees, yabbies under the mud, etc.

Reiterate how important mangroves are to all of these animals, and why these habitats need to be cared for.

### Optional excursion

Follow up with an excursion to your nearest estuary to meet the inhabitants in person. Use the ID guide to identify some of the plants and animals found in the estuary, and tick them off "bingo"-style when you have found them.

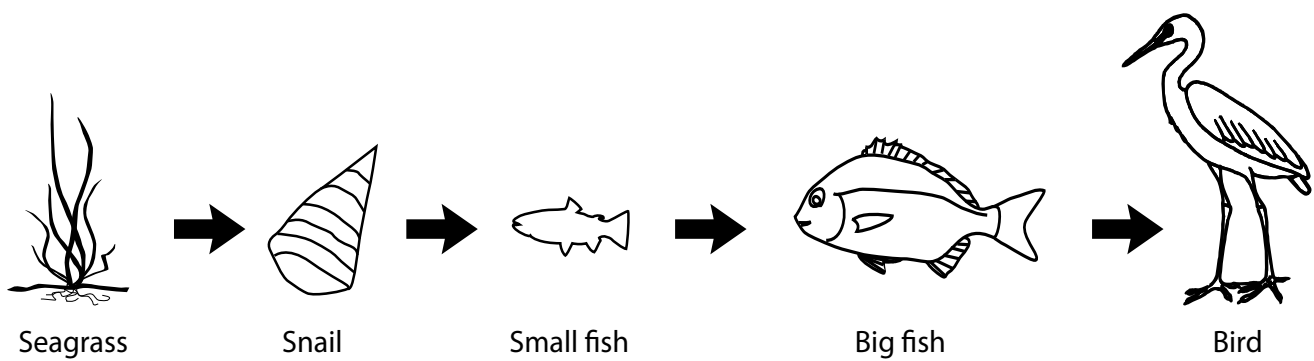
During the excursion, discuss which zone the estuary is in (refer to the Lord Howe Island Marine Park zoning guide provided in Module 1). For example, Old Settlement is habitat protection zone. Mud crab trapping and recreational line fishing are permitted in the habitat protection zone but not in the sanctuary zone. Which would you guess has a healthier population (larger numbers and larger sized animals) of fishes and crabs? Use the Estuaries Risk Analysis (pp.76-77) to ensure student safety.

### Possible locations within the Lord Howe Island Marine Park

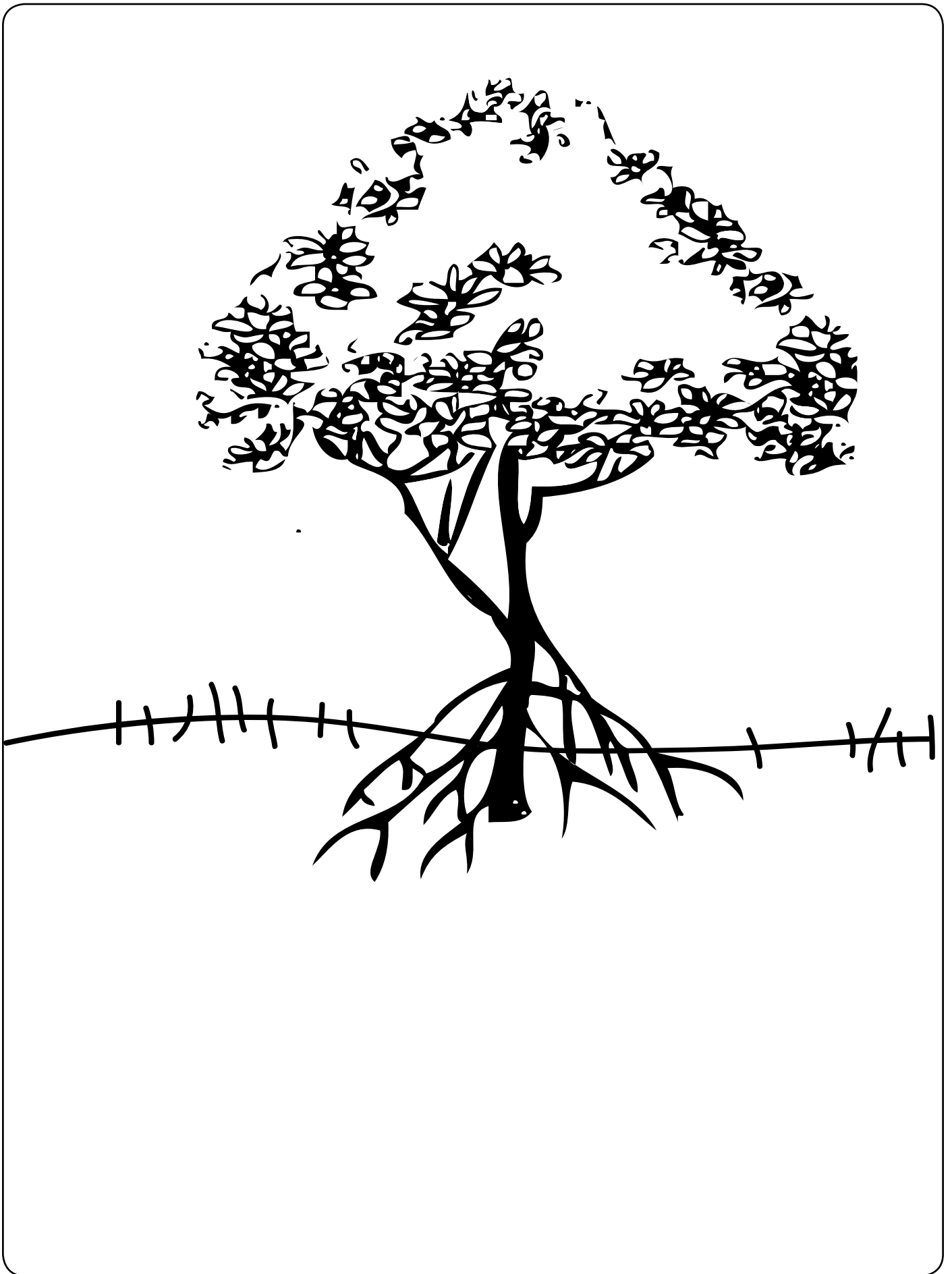
- Old Settlement Creek
- Soldiers Creek
- Cobbys Creek



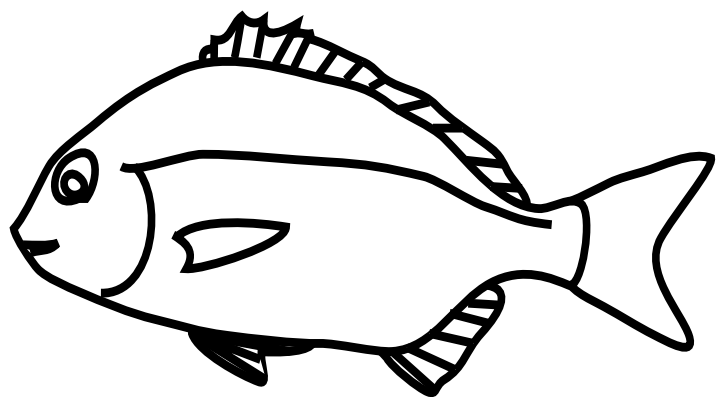
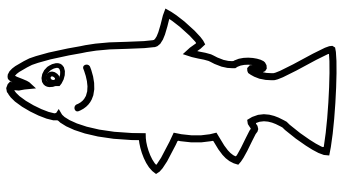
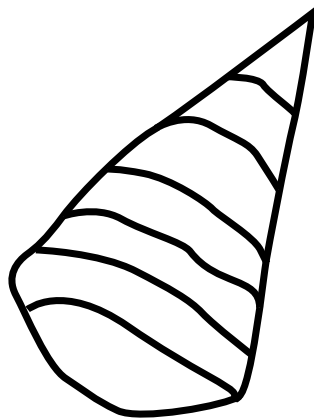
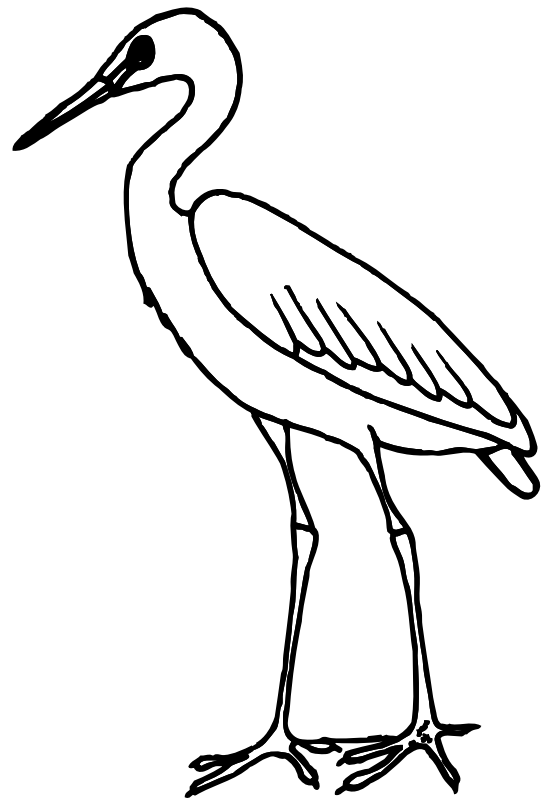
# Develop an Estuary Food Chain - EXAMPLE



# Activity Sheet - Develop an Estuary Food Chain



# Activity Sheet - Develop an Estuary Food Chain



# Stage 2 - Local Environments

## Teacher Activity Plan

### Level

Stage 2 - Local Environments  
COG Group A - Exploring Our Place

### Key Learning Areas

ENS2.5, ENS2.6, SLS2.13, PSS2.5

### Objectives

The objectives of this activity are: to identify local estuarine species; to use a range of problem-solving strategies when faced with issues in the natural environment; to identify who to contact in order to solve a localised problem; and to understand the difference between zones within marine park estuaries.

### Excursion Timing

The excursion must be undertaken at low tide. Check the tide times at:

<http://www.bom.gov.au/oceanography/tides>

### Equipment Used

- pencils
- sustainable bags
- rubber gloves
- clipboards

### Teacher Resources

Please contact the marine park office on 6563 2359 for a copy of all educational material on CD or to request staff attendance for excursion support. Additional resources are available on:

<http://www.mpa.nsw.gov.au>

<http://www.cleanup.org.au/au>

<http://www.waterwatch.nsw.gov.au>

<http://www.dpi.nsw.gov.au/fisheries/recreational/saltwater/sw-species/tiger-flathead2>

[http://www.ozcoasts.org.au/geom\\_geol/toolkit/mapfish.jsp](http://www.ozcoasts.org.au/geom_geol/toolkit/mapfish.jsp)

### About this program

This module is designed to cover ENS2.5, ENS2.6, SLS2.13 and PSS2.5, and when combined with the other three modules in this kit, addresses the key learning areas for COG Group A, Stage 2 - Local Environments. Follow up this module with the Marine Parks, Rocky Shores and Sea Country modules for further insight into the local environment. The modules are designed to address the NSW DET primary school curriculum, and can be used to complement current teaching programs.

Education material in this module consists of this **Activity Plan** to guide teachers through an activity, **Fact Sheets** to provide background information on estuaries, a student **Work Sheet** to record information, and an **ID Guide** for both teachers and students to identify the most common animals and plants found in estuaries.

### Activity 1 - Excursion

Choose a local estuary to visit and use as a case study. Use the ID guide to find some of the local inhabitants, and also look for signs of animals, such as whelk tracks through the mud, spider webs, and yabby and crab holes. Outline how important the plants are as both a food source and home for the resident animals. Discuss the place where the animals are found, and how important it is for them to have a safe home. How are these animals affected by human activities?

While in the field, discuss the issue of litter and pollution, and how it washes into the ocean to become marine debris. Reiterate that what happens on land influences the ocean: litter in rivers ends up as litter in oceans. Introduce the concept of storm water drains and rubbish catchers. Ask the students whether they would go swimming where it is heavily littered or polluted.

What can we do about this problem? We can help by:

- not littering
- picking up the rubbish we see
- participating in local "Clean Up Australia" days
- organising school clean up events, especially after heavy rains
- reporting pollution spills to the local council.

Using the litter survey sheet, conduct a clean up along the shores of your local estuary. Remember to estimate the length of the foreshore you have cleared. At the end, tally the results and congratulate the students on preventing the rubbish they have collected from entering the ocean. Use the Estuaries Risk Analysis (pp.76-77) to ensure student safety.

### Possible locations within the Lord Howe Island Marine Park

- Old Settlement Creek
- Soldiers Creek
- Cobbys Creek

### Activity 2

Use the mud crab activity to illustrate the benefits of sanctuary (or no fishing) zones compared to areas that can be fished. (Refer to the fact sheets and the Lord Howe Island Marine Park zoning guide provided in Module 1 for background information). This activity reflects research that has been conducted throughout various marine parks in Australia.

- Print out the mud crab image in different sizes.
- Explain the activity to the students using the teacher activity sheet.
- Help the students to graph their results.
- Discuss the benefits of protected areas as outlined in the fact sheets for Modules 1 and 3.
- Write up the key findings on the fish and display them in the classroom.

# Activity Sheet: Litter Survey

Area of estuary bank surveyed (length in metres): .....

Confectionery	Quantity
Lolly sticks	
Wrappers	

Total =

Beverages	Quantity
Glass bottles and pieces	
Plastic bottles and cups	
Plastic caps, straws and utensils	
Paper cups	
Tetra Pak cartons (e.g. Popper Juice)	
Aluminium cans	
Styrofoam cups/pieces	
Metal caps, ring pulls and pieces	

Total =

Organic	Quantity
Food	

Total =

Plastic Film	Quantity
Plastic film/cling wrap	
Plastic bags	
Plastic wrappers	
Plastic pieces	

Total =

Paper	Quantity
Paper bags	
Serviettes and tissues	
Paper pieces	
Newspaper	
Advertising materials	
Takeaway boxes	
Cardboard boxes and pieces	

Total =

Cigarettes	Quantity
Cigarette butts	
Cigarette packets, wrappers, foil and matches	

Total =

Unidentified	Quantity

Total =

Total number of litter items collected: .....

# Activity Sheet - Mud Crab Teacher Reference

## Background

Mud crabs are commonly found in muddy mangrove areas throughout NSW and Australia. Mud crabs are a popular target species for many fishers. The legal size limit in NSW is 8.5cm, and the bag limit is five. Size limits and bag limits are different in different states. For example, in Queensland, female mud crabs are not allowed to be taken, and the size limits are higher.

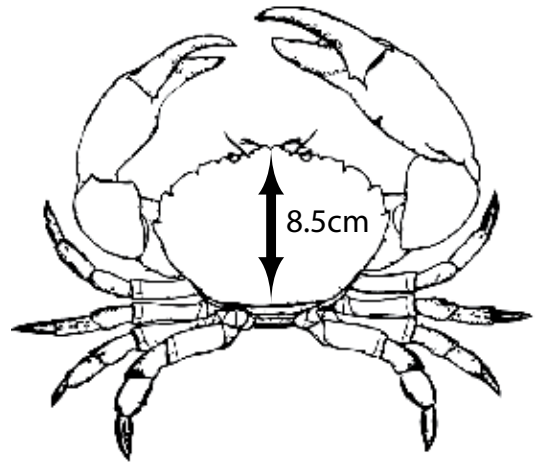
The aim of this activity is to highlight key habitat sites for species such as mud crabs. Additionally, the activity aims at highlighting the importance of bag limits and size restrictions. Size restrictions are in place so that individual species have a chance to mature, mate and reproduce. Bag limits work by restricting the number of mature males and females taken so that there is a greater chance of successful breeding. These measures ensure a quantity of future populations.

Mud crabs are a widely lucrative species for fishers as they are in great demand in the seafood industry; protecting the species is thus essential to guarantee their survival. Habitat protection is important in protecting many different species. At Lord Howe Island, there are limited mangrove areas and, therefore, the mangrove areas that are present need to be looked after so that animals such as mud crabs can have a place to live.

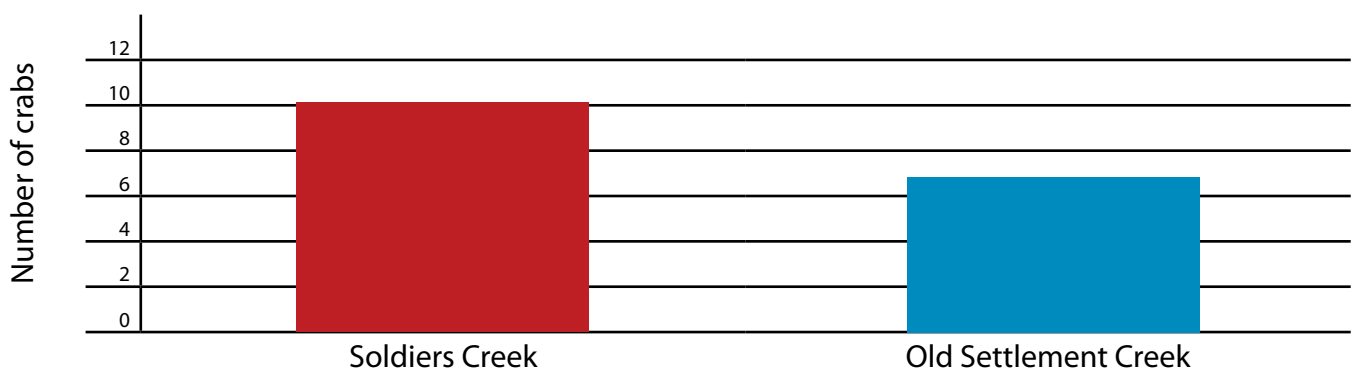
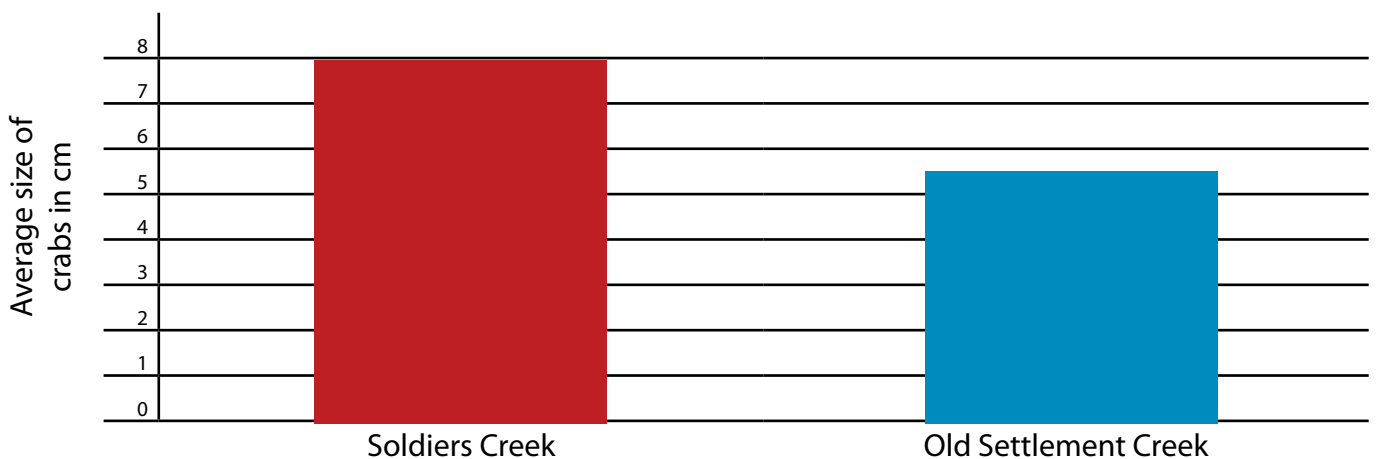
## Activity

- Print out the mud crab at a range of different sizes, cut them out, and laminate them if time permits. 15 to 20 should be sufficient.
- Allocate six areas on the floor: three Soldiers Creek areas and an additional three Old Settlement Creek areas. Label these areas as such.
- Place the crabs into their "study sites" around the room, with more crabs and larger crabs at Soldiers Creek as this is a larger area and would contain greater populations of crabs
- Break the class into small groups/pairs to make measuring easier.
- Each group/pair should have a data sheet (student activity sheet), a pen and a ruler.
- Students then rotate around the six sites, entering data on the sheet by: (1) recording the number of crabs at each site, and (2) measuring the carapace of each crab at each site with a ruler.
- Next calculate the mean sizes of crabs at Soldiers Creek and Old Settlement Creek, and graph the results. The final step is to calculate the total number of crabs in each area and compare the difference between areas.
- At the end of the activity, discuss the results with the students and come up with some key points. These can be written on the back of the crabs and then pinned up around the room or on a board. Some example discussion points may include:
  - o Crabs like to live in mud around mangroves.
  - o Mangroves are important habitats for many animals.
  - o Fishers like to catch mud crabs.
  - o Bag limits and size restrictions are important for protecting mud crabs
  - o Marine parks play an important role in protecting mud crabs and other marine animals.

This picture of a mud crab shows how to measure its carapace length. Use these pictures to demonstrate this to the class. Also use the second picture (below right) as a printout for the activity.



	Soldiers Creek			Old Settlement Creek		
	Area 1	Area 2	Area 3	Area 1	Area 2	Area 3
Average length of each crab caught (cm)	7	8	5	6.5	6	4
	6.5	9	7.5	5	7	5.5
	8.5	8	8	5		
	10					
Number of crabs caught	4	3	3	3	2	2
<b>Total number of crabs</b>	<b>10</b>			<b>7</b>		
Average sizes of crabs	8	8.5	7	5.5	6.5	5
	<b>Average size of all Solders Creek crabs = 8cm</b>			<b>Average size of all Old Settlement Creek crabs = 5.6cm</b>		



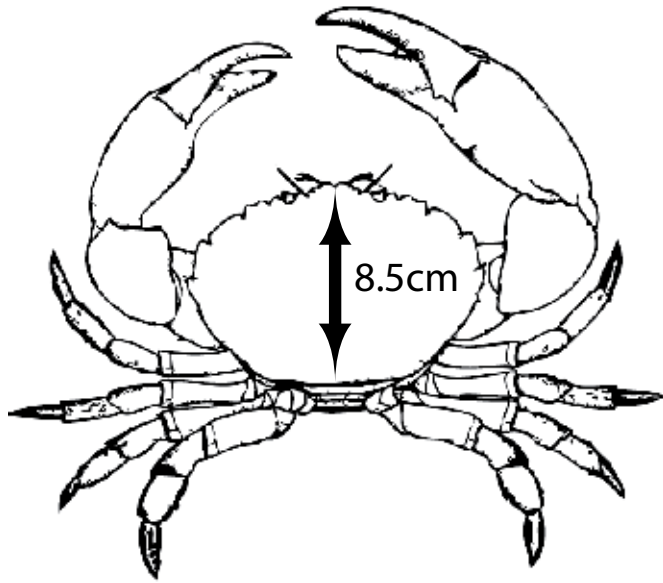




# Activity Sheet - Mud Crab Data Sheet

## Introduction

Mangrove areas are very special habitats that are important to many plants and animals. Mud crabs love to live in the soft, muddy sediment of these mangrove environments. In NSW, fishermen are only allowed to take five mud crabs, and they have to be at least 8.5cm in length.



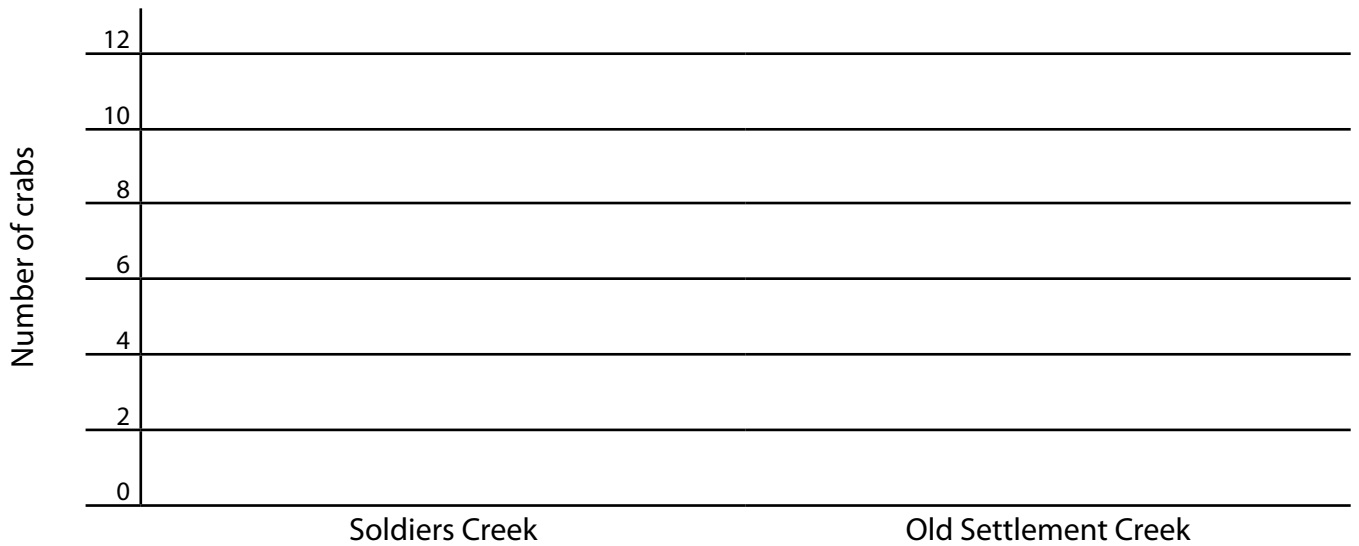
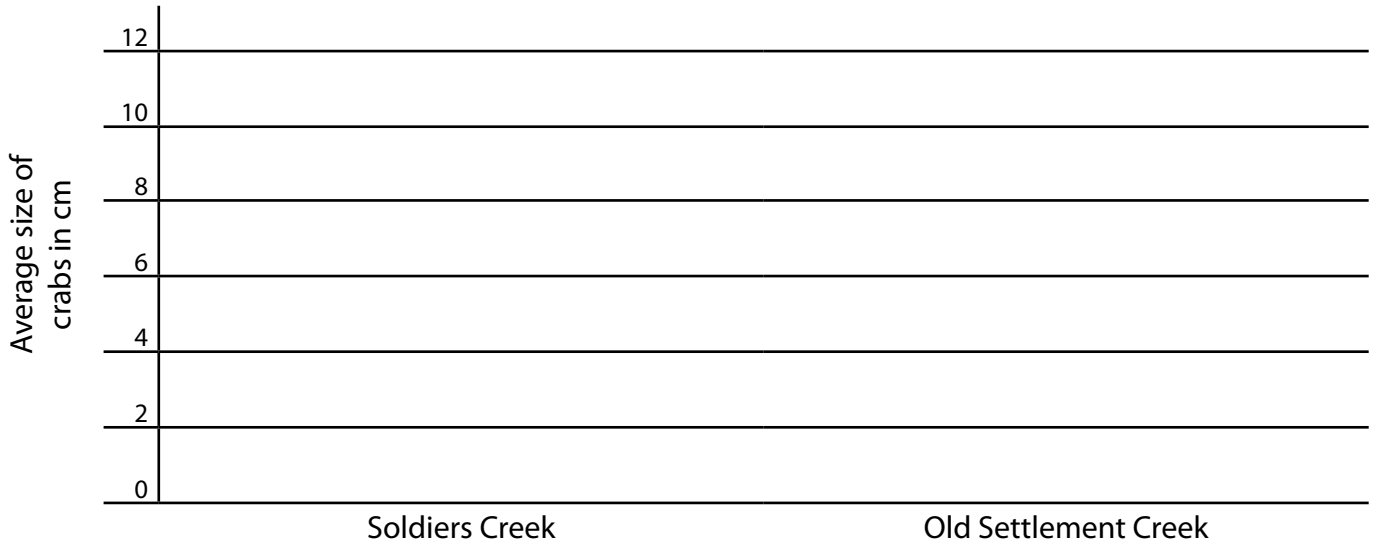
## Activity

You are a researcher studying the sizes of mud crabs trapped in two of the mangrove areas on Lord Howe Island (Soldiers Creek and Old Settlement Creek). In small groups:

1. Measure the size and count the number of crabs at each site.
2. Record the details in the table below.
3. Get your teacher to help you calculate the mean sizes of the crabs.
4. To show the difference between the numbers and sizes of crabs between each site, fill in the graphs over the page. (Your teacher will show you how to enter these results in.)

	Soldiers Creek			Old Settlement Creek		
	Area 1	Area 2	Area 3	Area 1	Area 2	Area 3
Average length of each crab caught (cm)						
Number of crabs caught						
<b>Total number of crabs</b>						
Average sizes of crabs						
	<b>Average size of all Soldiers Creek crabs =</b> _____ cm			<b>Average size of all Old Settlement Creek crabs =</b> _____ cm		

## Results



## Discussion



Which column shows the highest number of crabs? .....

Which column shows the largest crab measured? .....

Do you think the area with the most crabs should be protected by a marine park? .....

Why? .....

.....

Do you think that the rule for the amount of crabs you can take is a good idea? .....

Why? .....

.....

# Stage 3 - Living Land

## Teacher Activity Plan

### Level

Stage 3 - Living Land  
COG Group A - Exploring Our Place

### Key Learning Areas

ENS3.5, ENS3.6, DRAS3.1, DRAS3.2, DRAS3.3, DRAS3.4, MUS3.3

### Objectives

The objectives of this activity are: to develop an understanding through role-play of the different interests held by stakeholders and users of marine parks; and to determine how such groups can act in an ecologically responsible manner.

### Excursion Timing

The excursion must be undertaken at low tide. Check the tide times at:

<http://www.bom.gov.au/oceanography/tides>

### Equipment Used

- paper
- pencils

### Teacher Resources

Please contact the marine park office on 6563 2359 for a copy of all educational material on CD or to request staff attendance for excursion support. Additional resources are available on:

<http://www.mesa.edu.au>

Link to habitat mapping fact sheets on saltmarsh and estuaries:

[http://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0020/236234/mangroves.pdf](http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/236234/mangroves.pdf)

<http://www.waterwatch.nsw.gov.au>

### About this program

This module is designed to cover ENS3.5, ENS3.6, DRAS3.1, DRAS3.2, DRAS3.3, DRAS3.4 and MUS3.3, and when combined with the other three modules in this kit, addresses the key learning areas for COG Group A, Stage 3 - Living Land. Follow up this module with the Marine Parks, Rocky Shores and Sea Country modules for further insight into the local environment. The modules are designed to address the NSW DET primary school curriculum, and can be used to complement current teaching programs.

Education material in this module consists of this **Activity Plan** to guide teachers through this group activity, a **Fact Sheet** to provide background information on estuaries, a student **Work Sheet** for gathering information in the field, an **ID Guide** for both teachers and students to identify the most common animals and plants found in estuaries, and **Information Cards** to help students understand the group they are representing in their debate.

### Activity 1 - Excursion

Choose an estuary in the local area. Using the fact sheets provided and any additional resources, students then undertake research on that estuary. (Activity Sheet 1 will help to guide their research.)

Visit this estuary on an excursion. Introduce the program, and brief the class on the safety issues involved with the excursion using the Estuaries Risk Analysis (pp.76-77). Break the class into small groups and explain that the information they gather will eventually lead to a role-play back in the classroom (see Activity 2).

On a large piece of paper, get the students to draw an outline of the estuary, illustrating where the major habitat types are (mangrove, seagrass, etc.). Include other features of interest, such as jetties, ramps, boardwalks and shops.

Note: If an excursion is not possible, display a photo of a local estuary in the classroom. You could also use Google Earth or Google Maps to help identify some of the features in the surrounding area.

### Activity 2

This activity outline is a guide only that can be modified by staff into an interactive class activity. Break the class into groups and hand out the cards to the students, informing them of their group's issues (use as few or as many as necessary). In their groups, the students are to formulate a discussion/debate supporting their stakeholder group.

Each group will have positive and negative points that the debaters must emphasise to illustrate their point. The group then chooses a representative to debate their cause.

The outcome is for the class to come to a decision on how the estuary is to be managed sustainably while trying to satisfy the desires of the different stakeholders. Use the estuary drawing to help plan the outcome. Discuss this as a class, asking "What can the estuary cope with?" and "What will the impacts be?", and keep in mind that:

- The estuary can be divided into different zones to accommodate all activities.
- Conditions can be made. For example: line fishing can occur in some areas but not in others, or not at certain times of the year; or perhaps building can go ahead as long as the structure is a certain distance from the water's edge, complies with environmental standards so that as little impact occurs on the natural environment as possible, barriers are put up to stop waste entering the water, and, to compensate for habitat that is destroyed, areas that need revegetation are replanted.

# Activity Sheet 1 - Research a Local Estuary

Answer the following questions, and then write a paragraph describing the estuary. The marine park fact sheet may help you answer some of these questions.



1. Is the estuary open to the ocean?  
 .....

2. Does the estuary include the following vegetation? Use the ID guide to help you identify these plants. Tick "yes" or "no", and then estimate the amount of vegetation present by placing a tick in the appropriate box.

Vegetation	Yes/No	Sparse	Patchy	Dense
Seagrass				
Mangroves				
Saltmarsh				
Weeds				
Paperbarks				
She-oaks				

3. Does the estuary have a large or small catchment area?  
 .....

4. Is the land around the estuary flat or hilly?  
 .....

5. Does the land around the estuary have many buildings (houses, schools, shops, etc.)?  
 .....  
 .....

6. Is there rubbish in the water and/or along the banks?  
 .....  
 .....

7. Are you allowed to fish here? If so, is it a good fishing spot? (Can you see people fishing from the banks or in boats?)  
 .....

8. Is there a walking track or boardwalk for people to access the estuary?  
 .....

9. Are there any local Aboriginal sites (such as middens) along this estuary?  
 .....  
 .....

10. Use this information to describe this estuary and its importance for natural, community and cultural values.  
 .....  
 .....  
 .....  
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 .....

# Activity Sheet 2 - Debating for Sustainability

In small groups you will be assigned a "stakeholder" group that your team will be representing: either a developer, a conservationist, a group of local Aboriginal Elders, a tourist operator, a recreational fisher, or a researcher.

Look back on the information you gathered from the estuary research to help make your point. Using the cards you have been given, plan a discussion for your group. Use this page to help make an argument to represent your group.

Each stakeholder group will then make a presentation, outlining the ways in which they would like to see the estuary managed for future generations. Developers should speak first.

## Aim



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## Key Messages



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## Card 1

### Developer

The land on the bank of this estuary is perfect for development. We want to build a new housing complex here because:

- The units will have estuarine and sea views, which will attract people to buy the units, which increases our profits.
- We can attract people to live here who love to fish.
- No one needs or uses this part of the estuary, and it's full of sandflies. We will fill in the mud with concrete and make it look great by planting beautiful gardens.
- It will be a great place for tourists to come and stay, and they will spend money in our local shops.

## Card 2

### Conservationist

This estuary has a range of habitat types, such as (*describe what was found on the excursion*), which are homes to a large variety of animals. Fishes and crabs use these areas as nursery grounds, so we need to protect a large amount of this habitat. If the estuary is damaged, all the young fishes might die.

Seagrass and mangroves are protected through the Fisheries Management Act, and it is illegal to destroy them.

Mangroves are important in reducing erosion of the nearby land from water movement, and to filter pollutants from runoff.

If hundreds of people come here, they will have a huge impact on this area by increasing the levels of rubbish and pollution.

## Card 3

### Local Aboriginal Elders Group

Our people have been using this estuary for thousands of years. We still use the bay today to harvest fish, and we don't want them to be poisoned or moved away because of pollution or damage caused by new buildings.

There is a midden site here where our ancestors left shell and bone remains many years ago, and this area is sacred to us.

Some of the mangrove trees are scar trees where we cut out our shields, so we also want these trees preserved.

We don't want large numbers of people trampling our sacred sites.

## Card 4

### Tourist Operator

Such a beautiful environment will attract many tourists! We can attract hundreds of people to explore this estuary, and hire out motor boats to them, and organise fishing events.

We will need more tourist accommodation: maybe a caravan park near by, some toilet blocks and some barbeque areas.

This natural environment is perfect for eco-tourism. We can provide canoeing tours, guided walking tours and bird watching events.

We can increase visitors' spending money in our local community by advertising, and even attract people here from all over the world.

## Card 5

### Recreational Fisher

Our families have been fishing in these waters for generations. We have always caught good numbers of fish here.

This estuary is important to the locals and needs to be kept local. This is where we catch our dinner! Lots of new people will reduce fish stocks and damage the habitat.

A new boat ramp would be good, though, for better access to the estuary.

We don't want too many "outsiders" coming in here, competing for – and scaring off – our fish.

## Card 6

### Researcher

This estuary is an ICOLL, so it is not always open to the sea. Studies show it is very sensitive to pollution because of this feature as not much new water gets in.

Any changes to the land surrounding the estuary may increase pollution.

Research shows this estuary is an important area for juvenile fishes and shellfish, and contains valuable seagrass beds.

According to climate change research, the sea is predicted to rise, so any new developments must be carefully considered.

# Estuaries Risk Analysis

<b>Location:</b>		<b>Project/Job Name/No:</b>		<b>Date:</b>	
<b>Work Activity/Task:</b> School excursion to estuary.		Staff consulted:		<b>Signature:</b>	
<b>Item</b>	<b>Job step</b> Break the job down into steps.	<b>Potential dangers and incidents</b>	<b>Risk rating</b>	<b>Controls to prevent incidents</b> What you are going to do to make the job as safe as reasonably practicable.	<b>Person who will ensure this happens</b>
1	Communications with staff	Participant gets lost/Accident/ Other unforeseen event	M	<ul style="list-style-type: none"> <li>• Make role calls at regular intervals, including commencement and finish, and implement a buddy system setup.</li> <li>• Give a safety brief to participants at the beginning of the activity.</li> <li>• Advise administration staff of departure and arrival times.</li> <li>• Ensure at least one staff member has relevant first aid certification.</li> <li>• Carry a mobile phone, map and first aid kit.</li> <li>• Ensure mobile phones are charged before departure.</li> </ul>	Teaching staff
2	Weather conditions	Storm conditions/ Exposure	M	<ul style="list-style-type: none"> <li>• Check the weather and tides prior to leaving for the activity. (The activity must be undertaken at low tide.)</li> <li>• Ensure participants are correctly attired (i.e. with a hat, long-sleeved shirt, or a jacket if it is cold or rainy), and include such needs on the excursion consent form.</li> <li>• Have sunscreen and water available for participants, and include such needs on the excursion consent form.</li> </ul>	Teaching staff
3	Wet, slippery boardwalk/ Muddy areas	Falling over and subsequent injury, such as cuts or sprains	M	<ul style="list-style-type: none"> <li>• Brief participants on the care needed when walking on slippery surfaces.</li> <li>• Review the study area and identify slippery patches and trip hazards.</li> <li>• Ensure that all participants have appropriate footwear, and include such needs on the excursion consent form.</li> </ul>	Teaching staff



Item	Job step Break the job down into steps.	Potential dangers and incidents	Risk rating	Controls to prevent incidents What you are going to do to make the job as safe as reasonably practicable.	Person who will ensure this happens
4	Falling into estuary	Drowning	H	<ul style="list-style-type: none"> <li>Ensure sufficient staff are in attendance to provide the appropriate "high risk" level of supervision.</li> <li>Brief participants on the care needed near the water (e.g. stay away from the edge of boardwalks and the estuary edge, and make sure a "buddy" system is implemented).</li> <li>Ensure participants are sensible around the water's edge.</li> <li>Ensure participants are visible at all times.</li> </ul>	Teaching staff
5	Dangerous fauna	Snakes and stingrays	M	<ul style="list-style-type: none"> <li>Warn children to watch where they walk. If a snake is sighted, they are to stop walking and inform a teacher.</li> <li>Students are not to walk in the water; however, if this is necessary, then they are to shuffle their feet so as to kick stingrays out of the way.</li> </ul>	Teaching staff
6	Cuts	Broken glass	M	<ul style="list-style-type: none"> <li>Make children aware of any broken glass, tell them not to touch it, and let the staff pick it up.</li> <li>Wear appropriate footwear.</li> </ul>	Teaching staff

Reviewed by:

\_\_\_\_\_

Principal/Executive

\_\_\_\_\_

Signature

\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_

Date

Risk Assessment Rating:

- E Extreme risk; immediate action required
- H High risk; senior management attention needed
- M Moderate risk; management responsibility must be specified
- L Low risk; manage by routine procedures.