Mangrove animals

The flora and the fauna

A teaspoon of mud from a North Queensland mangrove contains more than 10 billion bacteria. These densities are among the highest to be found in marine mud anywhere in the world and are an indication of the immensely high productivity of this coastal forest habitat.

Mangrove plants produce about one kilo of litter (mainly leaves, twigs, bark, fruit and flowers) per square metre per year. Some of this is consumed by crabs but most must be broken down before the nutrients become available to other animals. That is where the bacteria, along with fungi, come in. Dividing sometimes every few minutes, they feast on the litter, increasing its food value by reducing unusable carbohydrates and increasing the amount of protein — up to four times on a leaf which has been in seawater for a few months.

Partly decomposed leaf particles, loaded with colonies of protein-rich micro-organisms, are then eaten by fish and prawns. They in turn produce waste which, along with the smallest mangrove debris, is munched up by molluscs and small crustaceans. Even dissolved substances are used by plankton or, if they land on the mud surface, are browsed by animals such as crabs and mud whelks.

This process is not confined to the mangroves. While some litter is recycled on the spot, this system is one of the few to export much of the organic matter it produces. Every time the tide retreats it carries a cargo of food out to sea. Studies of the mangroves at the northern end of Hinchinbrook Island have shown that they export more than 12 500 tonnes of litter per year into the Great Barrier Reef lagoon. This material is deposited over an area of 260 square kilometres of seabed. Here bacteria densities are almost as high as those in the mangrove mud and they do much the same job, breaking down the litter to be consumed by bottom-living fauna, by prawns and fish.

The seafood industry is the fifth largest primary industry in Queensland, with an annual commercial catch worth around $250 million. An estimated 75 percent of commercially caught fish and prawns depend directly on mangroves at some time in their lives or feed on food chains leading back there. Since those species making up the remainder of the catch probably also owe much to nutrients exported from the mangroves, these coastal forests can be seen as one of our major assets.

Where d'ya reckon all the fish have gone?

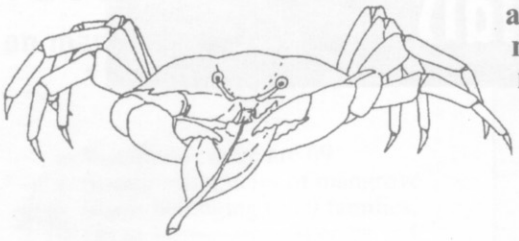
The white-bellied sea-eagle is a top predator in the mangrove food chain.

Integrated systems

Although mangrove plants and animals are being dealt with in two different chapters, to divide up an ecosystem in such a way is very artificial. Plants and animals are intimately related and their interdependence is no less a feature of the mangroves than of other ecosystems. Animals pollinate the flowers but eat seedlings and foliage. They shelter among branches or among roots where their burrows improve the soils. They prune growing tips but enrich the soil with their droppings. They damage living leaves but feed on discarded ones, recycling the nutrients.

By the same token, ecosystems do not exist in isolation from each other. Organisms in the mangroves become components of food chains which reach far beyond their boundaries, linking one system to another.

Crustaceans in the mangroves

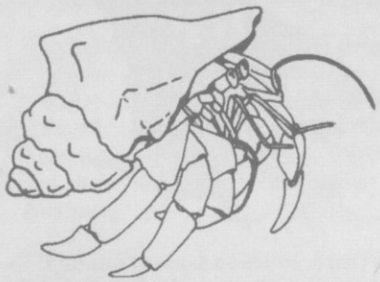


Of all the animals in the mangroves the crustaceans — crabs, prawns and shrimps — are probably the most conspicuous and among the most intriguing. There are at least 70 different species in Australian mangroves, of which about 65 percent are crabs.

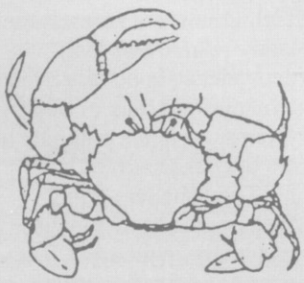
Many crustaceans in the mangroves make burrows which are used for refuge, for feeding, as a source of water or for establishing a territory necessary for mating. Some may filter water through their burrows, feeding on suspended detritus and plankton, while others may breed there. Certainly these burrows play an important role in the mangroves, aerating, draining and turning the dense waterlogged soil — a direct benefit to the plants which in turn give them shelter.

There is a limit to how many burrows can be dug in any one area. It seems that when there are too many burrows, homeless crabs may try to take over occupied ones. Some fiddler crabs and ghost crabs have been observed filling in the burrows of their neighbours to maintain their territories! Like other burrowing mangrove creatures, many crabs tend to be nocturnal, the majority appearing at night on a rising tide and remaining in their burrows by day to avoid predatory birds. Fiddler crabs are a notable exception.

Among mangrove roots, the obvious mud towers, up to 75cm high, belong to the **mud lobster**, or mud prawn. Underneath the mound its U-shaped burrow extends up to 1.5m below the surface. Since it is beneath the water table there is always a pool of water at the bottom enabling this animal to live quite far up the shore. Entrances to its mound are usually blocked by day with a mud plug, the lobster feeding on surface mud at night. This crustacean plays a significant role in turning over and oxygenating mangrove mud. Its mounds are home to high numbers of polychaete worms.



Hermit crabs are a familiar sight in their borrowed shells; they are the mud whelks which move too fast! Mangrove species feed largely on surface detritus, unlike species elsewhere which feed on larger items.

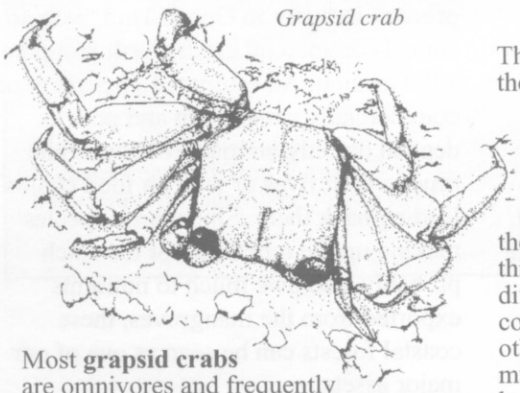


After mating, female **mud crabs** migrate up to 30km offshore and to depths of 300m to spawn. The larvae eventually drift inshore, moult and, as juvenile crabs, burrow into the substratum of mangroves and seagrass beds. As adults they move to the mudflats, using mouth parts to crush food such as molluscs or small crabs and powerful claws for larger prey. Mud crabs are largely nocturnal.

Two crab families

Mangrove crabs in northern Australia come from two main families, the grapsids and the ocypodids. Grapsids have a broad front with eyes on short stalks, a square mouth frame and a marked gap between the claws. The latter, including the fiddler crabs, have long eye stalks situated closer together, a mouth frame which is not so square, and closer claws.

Grapsid crab



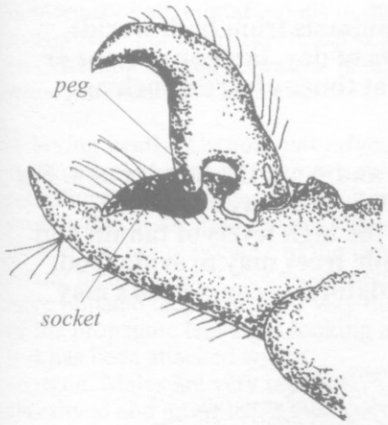
Most **grapsid crabs** are omnivores and frequently collect fallen mangrove leaves, sometimes fighting over them before dragging them into their burrows to feed. It is not known how leaf-eating crabs deal with the high tannin content in the leaves, a deterrent to most other animals. They may choose leaves which have had the tannins leached out, or species with low tannin levels, or they may be physically adapted to deal with them. These crabs play an important role in the recycling of nutrients in the mangrove system although, on the other hand, they are also a major consumer of mangrove seedlings. They also represent one link in a rather short and efficient food chain, eating mangrove leaves and being eaten by predatory fish — which are in turn preyed upon by us.

Although grapsid crabs, like fiddlers, build burrows, they do not retire underground when the tide comes in, climbing up mangrove trunks instead to avoid marine predators. Their burrows are used primarily as dining rooms.

The majority of **ocypodid crabs** feed on the nutrient-rich surface mud or sand. The grains are scooped up, rolled around in their mouth cavity and stripped of any slime and bacteria coating the particles by specialised feeding hairs. The fineness of these hairs dictates where on the shoreline the crabs can live and for this reason different species are found in different zones. Some species have very coarse hairs only suitable for sand, while others have finer hairs and do best on muddier substrate. Once the food particles have been removed the remains are spat out as small round balls. As many different types of crabs feed in the same way, these small round balls are a common feature around crab burrows. Most crabs arrange the balls radially, leaving clear paths back to their burrows in case they need to retreat quickly.

Mangrove crabs are adapted to living out of water for relatively long periods. Certain ocypodid species retain water in their gill chambers, replenishing it regularly in pools of water or in burrows. Some fiddler crabs do this by squatting in water and absorbing it through an opening between the third and fourth legs. Some crabs simply reoxygenate the water in their gill chambers as it gets stale, by passing air through it or by cycling it over the shell and back to the gill chamber.

Many mangrove crustaceans have thickened shells to reduce evaporation. This would also give them some protection from predatory birds.



A characteristic noise of the mangroves is a loud crack or pop produced by the rarely seen **pistol shrimp** which inhabits the more fluid soils in wetter parts of the mangroves. The sound is produced by the animal snapping its enlarged claw which contains a unique peg and socket arrangement. It is thought to be a territorial signal and/or a noise made to deter predators.

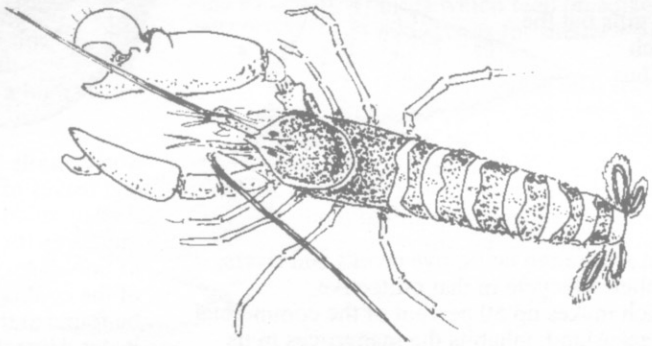
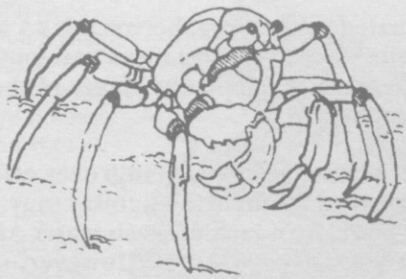


Illustration courtesy Esther Cullen



Distinctive blue-shelled **soldier crabs** form 'armies' sometimes thousands strong as they move around the tidal flats feeding on surface sediments. They are fairly unique among crabs in that they walk forwards instead of sideways. Preyed on by a number of animals they can quickly vanish into the mud using a distinctive 'corkscrew' burrowing technique. Before high tide each crab builds an igloo-like convex mound over its burrow. When the tide recedes again they emerge one by one until large numbers of them appear on a previously empty beach. Juvenile soldier crabs frequent mangroves and seagrass beds while adults prefer nearby mudflats.

Focus on fiddlers

Fiddler crabs are some of the most colourful animals found in mangrove forests. There are about 70 species worldwide. Although they can be found at quite high latitudes in North America, in Australia they are more common in warmer areas, about a dozen occurring along the Wet Tropics coast. As fiddlers are quite small (usually less than 8cm across their backs) and easily disturbed, people rarely get a close look at them. The shadows of birds overhead will often trigger retreat by a whole community. Your shadow will have the same effect; only by sitting quietly can the fascinating social behaviour and vivid colours of these little crabs be appreciated. The jewel-like colours of some species have given rise to common names such as 'Darwin red legs', also known as *Uca flammula* which translates as 'little flame'.

The movements of the male's enlarged front claw, which can be on either the left or right side, gives the name to the group. Waving movements can be either in a beckoning or an up-and-down motion. As the female fiddlers do not have a large claw, they can be mistaken for another crab species, but their similar carapace (shell) colour gives them away.

Each fiddler crab species has developed a distinct stereotypical wave which is the signature for that species. The purpose of male claw waving has been a topic of debate among crab specialists for years. As males wave vigorously at other males moving close to their burrow entrances, territorial aggression has been postulated. However, males also wave at females prior to mating, thus waving also appears to play a part in courtship. Female crabs are very discriminating and will only mate with males which wave in the correct manner for their species. Males, however, will attempt to mate with any crab wandering past, even other males which have lost their large claw!

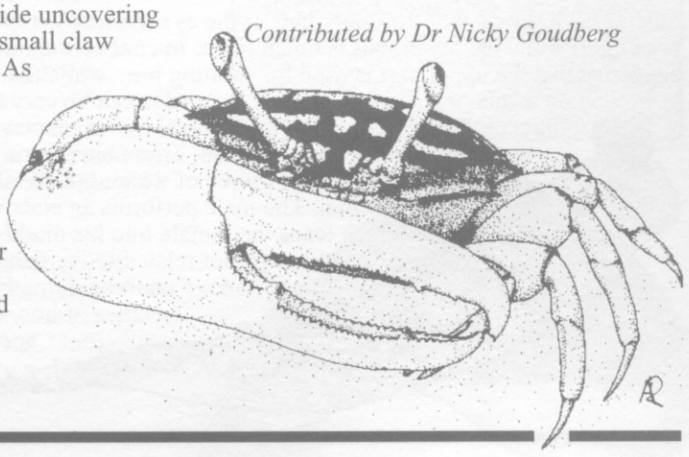
Claw loss due to fighting is infrequent as fighting is a highly ritualised process which rarely leads to physical contact — a bit like crab tai-chi.

During the high tide period the crabs remain down their burrows to avoid being eaten by predatory fish. They emerge to feed and socialise within about 30 minutes of the daytime tide uncovering their hideouts. Only the small claw can be used for feeding. As females have two of these they can feed at a faster rate than males. Because large males are often found to be in a poor condition, it is thought those with larger claws can't feed enough to maintain their size and may starve as a result!

Fiddler crabs have inbuilt clocks set according to the tides. This is demonstrated by their tendency to change colour. At low tide their normally brown legs become pale and their dark shells change colour. Some species turn blue while others develop orange or white markings. Only their claws remain the same. Young fiddlers also become pale at low tide. Experiments have shown that they continue to change colour in time with the tides even when removed from the marine environment and kept in aquaria.

When the weather is cool or the tide is coming in the crabs cease feeding, excavate a mud cap and retire to their burrows, placing the cap over the entrance as they go. These caps are so expertly sized and placed that the burrows disappear and are very difficult to relocate until emergence at the next low tide.

Contributed by Dr Nicky Goudberg

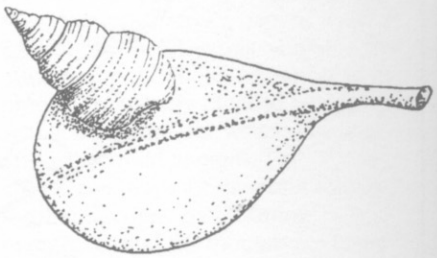


Life in the mangroves — animals of land and sea

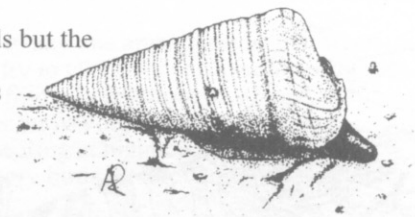
Situated as they are, between land and sea, mangroves provide food and shelter for animals from both worlds. While some are permanent residents, the majority are visitors, choosing certain times of day, tides or seasons or appearing at particular stages of their lifecycles, during migrations, for breeding or at times of stress such as droughts.

For marine animals, mangroves offer abundant food and protection from predators and from the hot dry sun. For terrestrial animals the habitat may simply function as an extension of their normal one. They are restricted, however, by a lack of fresh water and most herbivores are probably discouraged by the high levels of tannin and salt in mangrove leaves. However, seafood forms an important part of some diets while trees may provide food, such as nectar, in certain critical seasons. In addition, a reduction in numbers of predators or competitors may make mangroves an important habitat for breeding or roosting.
Here we look at some residents and visitors.

Mud whelks (below) are common snails on the surface of the mud where large numbers feed on algae and detritus. Often the lower surface of the shell is worn away, possibly corroded by the acidic mud.



Most marine molluscs breathe with the aid of gills but the ***Onchidium*** has instead developed a lung which enables it to breathe air — through its anus. Thus able to live out of the water, this slug can be found on the trunks and aerial roots of mangrove trees and on the mud surface. With its dark brown, bumpy skin, it blends so well as to be almost invisible.

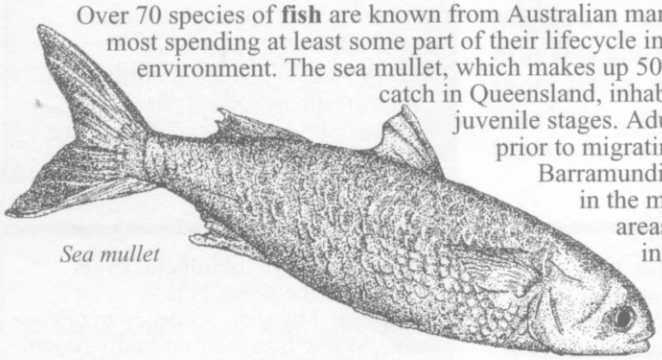


Some **snails** (above) live on the trunks and leaves of mangrove trees where they feed on microscopic plants. Some choose quite specific habitats, such as the leaves of only one species of tree. The juveniles of the common *Littorina scabra* tend to be found at the lower levels, near to the water. Here dark-coloured individuals are more common, lighter ones being more readily picked off by fish. Adults, however, are more frequent in the canopy where they develop a yellowish colouration, a camouflage which protects them from hungry birds. Some mangrove snails, when disturbed, drop off the leaf and suspend themselves by a thick mucous cord.

Since the adults are never immersed in water they tend not to lay eggs as many other molluscs do. Depending on the species, the females may brood the eggs in special pouches, releasing small numbers as free-swimming larvae on the new or full moon high tides or even retaining them until they have developed into tiny crawling snails.

Marine borers, a favourite Aboriginal food, are very abundant molluscs in logs where their tunnels and cavities create habitats for other animals. They are important decomposers of the wood.

Over 70 species of **fish** are known from Australian mangrove creeks and rivers, most spending at least some part of their lifecycle in that protective environment. The sea mullet, which makes up 50 percent of the commercial catch in Queensland, inhabits the mangroves in its juvenile stages. Adults also assemble there prior to migrating out to sea to spawn. Barramundi, on the other hand, spawn in the mangroves and inshore areas, the juveniles developing in estuaries before moving up the rivers.



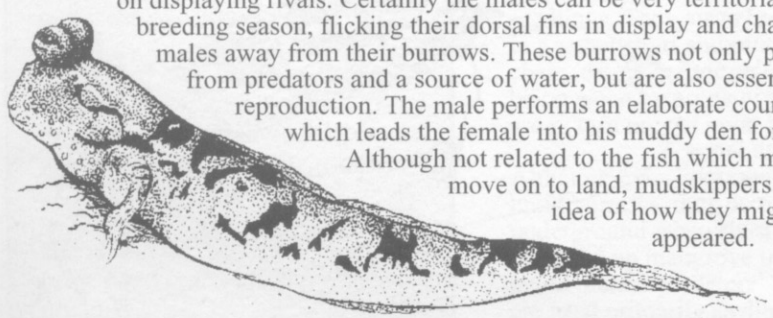
Sea mullet

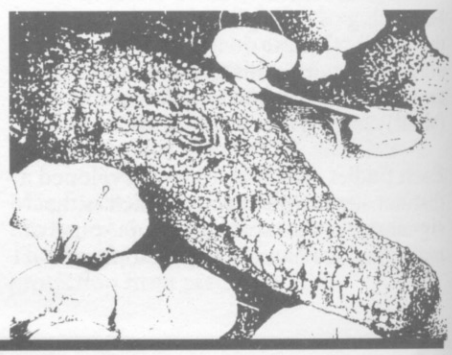
Mudskippers are one of the few fish which live only on tropical mangrove shores where their skittering movements are a typical sight. Often this is the first we see of them; they are well-camouflaged and able to change colour to match their background.

When submerged a mudskipper swims like any normal fish but out of water its specialised skeleton and muscles allow it to use its pectoral (front) fins as crutches, stretching them forward and swinging its weight on to them. The skipping movement is achieved by bending its tail forward to one side and propelling itself forward. Some species can climb, using their fused pelvic (rear) fins as suckers and their pectoral fins as grasping 'arms'. In water a mudskipper can skim across the surface, flying-fish style.

When a mudskipper is out of water it carries, in its expanded gill chamber, a reserve from which to extract oxygen. After a few minutes, when this reserve is exhausted, it is replenished from pools or from water in burrow. The mudskipper's mobile eyes bulge up from its head allowing it a wide-angle view which helps it locate prey (spiders, insects, crabs, worms, molluscs, and so on) and to spot predators. They also act as periscopes for the submerged fish. On land, the eyes are moistened, from time to time, by being 'blinked' down and immersed in a pool of water in the sockets.

Studies have shown that the upper half of the eye has many more rods (for vision in poor light) while the lower half is much richer in cones (for colour vision). It has been suggested that the upper part is used for spotting prey while the lower part keeps watch on displaying rivals. Certainly the males can be very territorial during the breeding season, flicking their dorsal fins in display and chasing other males away from their burrows. These burrows not only provide refuge from predators and a source of water, but are also essential for reproduction. The male performs an elaborate courtship dance which leads the female into his muddy den for mating. Although not related to the fish which made the first move on to land, mudskippers give us some idea of how they might have appeared.





Insects are the most diverse and numerous of all animal groups in the mangroves. For many this forest is simply an extension of their terrestrial habitat but some are found nowhere else.

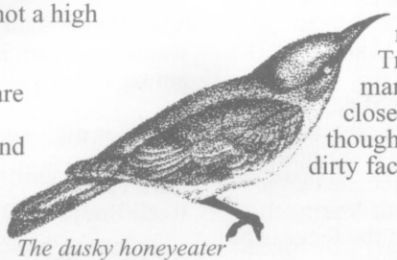
A boring **beetle,** *Coccotrypes fallax,* lays its eggs inside *Rhizophora* propagules (seedlings). Just as they are becoming established in the mud, many of them can be seen drooping because of the larvae eating them within. Once the beetles have pupated they bore their way out of the propagule leaving it looking as if it has been attacked with a shotgun. Males are very rare, shortlived and never leave the propagule. Unmated females can reproduce, a strategy adopted by certain insects where adverse, but stable, conditions mean that the adaptations which come with sexual reproduction are not a high priority.

Various species of **ants** are known from mangroves. Those which live at ground level are apparently able to trap air in their burrows with plugs of mud at high tide.

Some species of **flying fox** roost in the mangroves and nearby paperbark swamps. In the Wet Tropics black flying foxes, little red flying foxes and spectacled flying foxes (right) congregate in sometimes huge camps. Although they range far and wide at night in search of food, along with blossom bats, they feed on mangrove flowers, particularly mangrove apple, *Sonneratia alba*, in season.

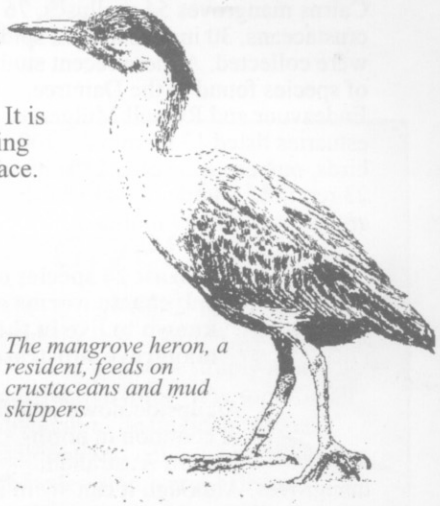
Pied imperial-pigeons nest in mangroves

Over 230 species of **birds** have been recorded in mangroves in Australia but numbers at any one time tend to be low, most being occasional visitors. Some, such as honeyeaters and lorikeets, may appear during the flowering season, in search of nectar, while others seek fruit or insects. Others may arrive during migrations or, like the pied imperial-pigeon, for breeding. A large number of visitors are wetland birds which feed on adjacent mudflats and estuaries but use the mangroves for shelter — for roosting and/or breeding.



The dusky honeyeater is a frequent visitor

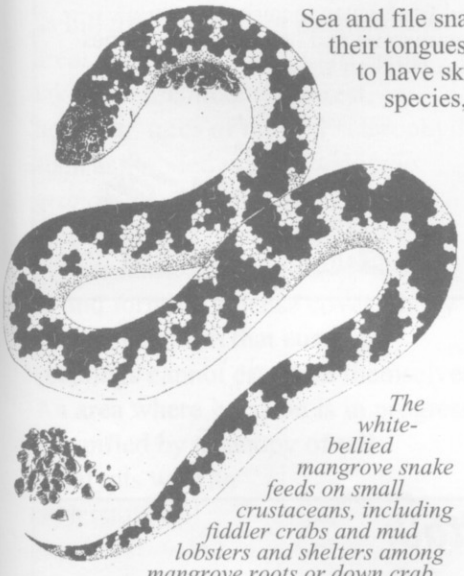
Only about eight bird species are restricted to mangroves in the Wet Tropics. It has been observed that many of these have longer bills than closely related species from elsewhere. It is thought this may prevent them from getting dirty faces while foraging on the mud surface.



The mangrove heron, a resident, feeds on crustaceans and mud skippers

Sea **snakes**, especially the banded sea krait, visit on high tides. Species of a more terrestrial origin which are found predominantly in the mangroves include the little file snake, the mangrove snake and the white-bellied mangrove snake (below). Pythons are attracted by large camps of flying foxes.

Sea and file snakes excrete salt from glands at the base of their tongues. In addition, snakes from the mangroves tend to have skins which are less permeable than other species, thereby stopping salt from entering.



The white-bellied mangrove snake feeds on small crustaceans, including fiddler crabs and mud lobsters and shelters among mangrove roots or down crab holes at low tide. It may enter the crab burrows in search of prey.

Monitor lizards, notably the mangrove monitor and the rusty monitor, frequent mangroves to feed on insects, fish, crabs and birds.

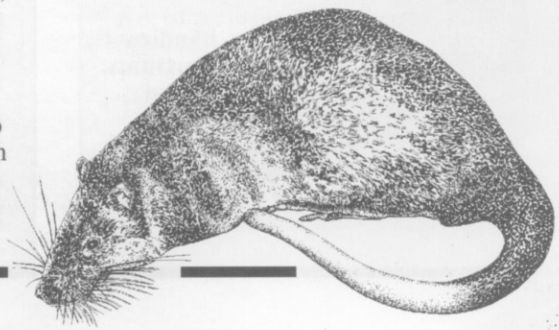
Few mammals live permanently in the mangroves. A notable exception is the very rare **false water rat**, a colony of which inhabits the mangroves of North Stradbroke Island. Small, grey with a white belly, it travels up to 3km a night feeding on crabs which it disables by biting off first the eye stalks and then the claws. Each individual protects a territory of about a hectare, fighting intruders if necessary. Despite its habitat this little rodent has no webbing on its feet and doesn't appear to like getting wet. It builds a mound of mud and leaves, honeycombed with tunnels, with a nesting chamber at the top. Researchers have suggested the new, and more appealing, name of 'water mouse' for this unusual little mammal.

The much more common **water rat** (right) sometimes builds its nest near to mangroves, feeding on crustaceans, fish and even young water birds. Unlike its little relative, it has partly webbed feet.

Estuarine crocodiles come into the mangroves on the rising tide to feed. Juveniles eat crabs, prawns, mudskippers and other small fish while older animals feed on large mud crabs, birds and mammals. They do not generally nest in the mangroves but on the banks of adjacent rivers. Estuarine crocodiles have salt-secreting glands at the back of their tongues which enable them to survive indefinitely without drinking fresh water.

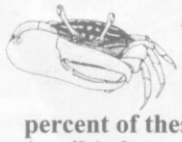
Bities in the mangroves

Biting midges, commonly but mistakenly known as sandflies, breed in quite restricted zones, necessary conditions differing according to species. The developing larvae mustn't dry out — or get too wet or they may drown. Despite the limitations, suitable sites are intensely used. Mangroves may allow midges to travel (the greatest distance travelled by a midge is 1.6km) but are not particularly good breeding sites for most species. In fact, cleared mangrove sites are much more suitable, some canal estates having proved perfect for certain species of this pest! **Mosquitoes** breed in quiet pools at the back of the mangroves particularly if disturbance such as dredging and filling has created stagnant pools.



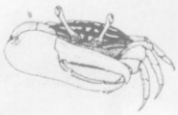
Facts and stats

on mangrove animals



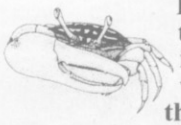
At least 100 species of molluscs are found in Australian mangroves. About 75 percent of these are gastropods (snails) the remainder being bivalves. The best-known of these is probably the mangrove oyster which colonises the trunks and aerial roots of the trees in large colonies.

In a 1970s study of animal species in the Cairns mangroves 54 molluscs, 76 crustaceans, 30 insects and 42 spiders were collected. A more recent study of species found in the Daintree, Endeavour and Russell/Mulgrave estuaries listed 13 mammals, 100 birds, numerous insects, 28 spiders, 23 reptiles, 3 amphibians, 33 fish, 47 crustaceans and 39 molluscs.



At least 24 species of polychaete worms are known to live in the mangrove substrate.

An upside-down jellyfish is common in north-eastern Australian mangroves. Although it can swim it generally lies upside-down on the substrate with its tentacles waving in the water, rather like an anemone. Like most hard corals, this jellyfish contains symbiotic zooxanthellae (algae) in its tissues which benefit from the sunshine in shallow water and help supplement their host's diet.



Fiddler crabs can fold their long eye stalks into slits at the side when they crawl into their burrows.

Pollination of most mangrove plant species is achieved with the help of birds, insects and wind. Bees are particularly important and can produce excellent honey from their visits. The flowers of mangrove apple (*Sonneratia*) and fresh-water mangrove (*Barringtonia*) open at dusk and are pollinated by moths and bats.

Wallabies, bandicoots, antechinus, possums, dingoes, pigs and cattle as well as a number of rodent species have all been known to visit mangroves, usually at low tide.

Bookshelf

See the bookshelf section of the previous chapter for general mangrove books.

The Reader's Digest Book of the Great Barrier Reef
Reader's Digest Services Pty Ltd

This book contains a chapter on mangroves and has references to mangrove inhabitants in other sections (check the index). It also describes the formation of low wooded islands, of which mangroves are an intergral part.

Tropical Mangrove Ecosystems
A.I. Robertson and D. M. Alongi (eds)
American Geophysical Union (1992)

An academic collection of papers, this book looks at all aspects of mangrove systems. Almost all the contributers to this book have been associated with the Australian Institute of Marine Science at some time so the focus is on local mangroves.

The Mud Crab
D.F.Fielder and M.P.Heasman
A Queensland Museum Booklet No. 11 (1978)

A very interesting and readable booklet on this one crustacean deals with its biology as well as catching and cooking.

Hermit Crabs of the Great Barrier Reef and Coastal Queensland
Christopher C. Tudge
Backhuys Publishers (1995)

This is useful as an identification guide to the most common species and has a key, descriptions and 24 colour photos.

Reader's Digest Complete Book of Australian Birds
Reader's Digest Services Pty Ltd

This is a good source of information on all birds, including those found in mangroves.

Crocodiles of Australia
Grahame Webb and Charlie Manolis
Reed Books Pty Ltd (1989)

This superb book is a must for anyone wanting to learn more about these animals.

Reptiles and Amphibians of Australia
H.G. Cogger
Reed Books (1992)

Snakes and lizards found in the mangroves are included in this 'bible'.

Australian Fishery Resources
Patricia J. Kailola, *et al*
DPI (1993)

A comprehensive reference to marine and freshwater species taken in commercial and recreational fisheries in Australian waters.

Tourist talk

ENGLISH	GERMAN	JAPANESE	
bacteria	Bakterien	bacteria	バクテリア
nutrients	Nährstoffe	eiyo bun	栄養分
crab	Krabbe	kani	蟹
mud skipper	Schlammspringer	mutsu goro	ムツゴロウ
mud whelk	Schlammschnecke	bai gai	ばい貝
shrimp	Garnele	ko ebi	小エビ
snail	Schnecke	katastumuri	カタツムリ
fish	Fisch	sakana	魚
crocodile	Krokodil	kurokodairu	クロコダイル
pollination	Befruchtung	jufun	授粉