

Tropical Topics

An interpretive newsletter for the tourism industry



Crocodiles

No. 29 July/August 1995

Notes from the Editor

Be cautious about crocodiles — but not paranoid. Statistics show that you are more likely to die from a lightning strike or bee stings than from a croc attack.

Activity	No of deaths (1980-90)
Crocodile attacks	8
*Box jellyfish stings	9
Shark attacks	11
Lightning strikes	19
Bee stings	20
Scuba diving accidents	88
Drownings/submersions	3 367
Traffic accidents	32 772

Adapted from *Shark Attack: Who's the victim* by John Stevens and John Paxton Australian Natural History Vol 24 No 3.
*Acknowledgments to Dr Peter Fenner.

Throughout this issue the common name **estuarine crocodile** is used in preference to **saltwater croc**. This is to emphasise that *Crocodylus porosus* is not confined to salt water but is also commonly found in fresh water.

Beware also of birds

There have been recent reports of tourists surrounding and feeding a cassowary at Lake Barrine National Park, something which happens also in other cassowary hot spots. This is a potentially dangerous situation which could lead to serious injury. Cassowaries are unpredictable and can attack suddenly, a hazard which tourists who are unfamiliar with wet tropics animals are unlikely to understand. (They are also unlikely to know that a hefty fine is attached to the deliberate feeding of a dangerous animal.) It is the responsibility of tour operators to warn their customers.

Croc casualties in perspective

Since 1867 there have been 27 confirmed fatal crocodile attacks in Australia. Tragic as these deaths are, the actual number pales into insignificance when compared with fatal road accident statistics: the *lowest* monthly road toll since records began in 1960 stands at 163 (May 1991).

Despite the vast difference in numbers, there is one common element — alcohol. A large number of deaths from both crocodile attacks and road accidents involve situations where judgement and commonsense were dulled because the (human) participants had been drinking.

The key to avoiding croc attacks is to exercise caution when in croc country — fresh water, tidal rivers and coastal waters along the entire coastal strip north from around Rockhampton. Crocodiles move about and can turn up unexpectedly. Just as we avoid swimming in coastal waters in summer because of box jellyfish and look before we cross a road, we should also allow for the possibility of encountering one of the few Australian predators large enough to consider us for lunch.

Crocodylians have been around for about 240 million years. They observed the rise and fall of the dinosaurs and the extinction of many other species. However, in just the last 50 years many of the world's 26 crocodylian species have come close to following suit, threatened by human hunters and habitat destruction.

Australian crocodiles are luckier than many, having been protected by law for about 20 years. However,

increasingly, humans are crowding in on their territory. Swamps, mangroves and rivers are rapidly being developed, the new inhabitants becoming outraged if crocodiles turn up in habitats which have been their home for millions of years. The bulldozer has become more of a threat to crocodiles than the bullet.

We need a sense of perspective. As Malcolm Penny wrote in his book *Alligators and Crocodiles*, "... the animals which have survived the greatest catastrophes the world has seen, the Cretaceous extinction and a series of Ice Ages, have every right to survive the impact of a small bipedal mammal which prides itself on being the only species ever to have evolved a conscience".



WET TROPICS
MANAGEMENT AUTHORITY



Queensland
Department of
Environment and
Heritage

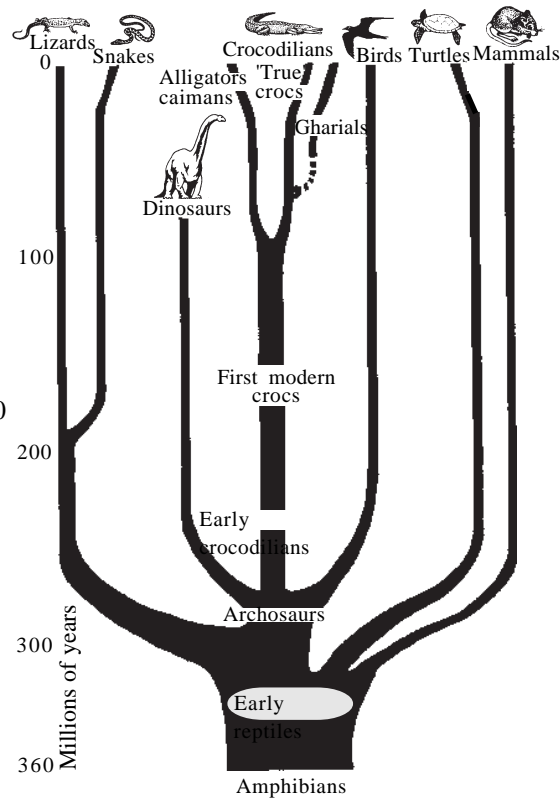
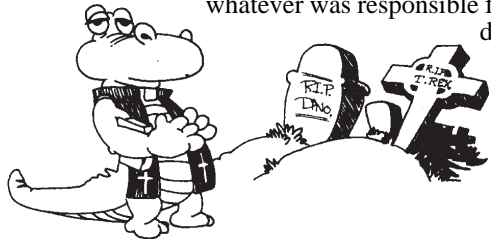
The family tree

When the evolutionary tree is traced back in time it becomes apparent that crocodylians are more closely related to birds than to lizards. The first reptiles evolved about 320 million years ago. From these little lizard-like creatures evolved mammals and birds as well as modern lizards, snakes, turtles and crocodiles.

As can be seen from the diagram, the lizard and snake branch as well as the mammal and turtle branches divided from the evolutionary tree quite early on. The Archosaur ('ruling reptiles') branch gave rise to birds and dinosaurs as well as crocs. Interestingly, all these animals share one particular feature, the manner in which the leg and feet are joined at the ankle. Lizards have a quite different arrangement.

One of the earliest life forms to develop on the Archosaur branch, about 240 million years ago, was a one metre-long, heavily armoured, narrow-snouted creature with hind limbs which were longer than the forelimbs — recognisably an early crocodylian. It was obviously a body plan which was to stand the test of time. Although this particular model became extinct the first modern crocs, which evolved about 160 million years ago, were very similar.

Crocodylians lived with, and probably preyed on, dinosaurs. So why did crocs not also become extinct, 65 million years ago? It would seem that whatever was responsible for the demise of the large land-dwelling reptiles did not affect those large reptiles which had made their homes in freshwater swamps. They were perhaps simply adaptable enough, as were mammals, turtles, birds, lizards and snakes, to survive the event.



Evolutionary tree adapted from *Crocodyles of Australia* by Grahame Webb and Charlie Manolis

When is a crocodylian an alligator?

For the last 60 million years or so, three main branches of the crocodylian family — 'true' crocodiles, alligators (including caimans) and gharials — have been evolving separately. Despite this their basic body plans remain very similar, the main differences being in the structure of their heads and jaws.

The most visible difference between crocodiles and alligators is the arrangement of their teeth, in particular the large fourth tooth in the lower jaw. When an alligator shuts its mouth this tooth disappears into a special socket in the relatively broad upper jaw but in a crocodile it is visible in a notch on the outside of the upper jaw. Gharials have distinctively elongated snouts.

Another interesting difference is the salt glands at the back of the animals' tongues (see p 4). They are much better developed in 'true' crocs, leading researchers to suggest that they may have evolved from a saltwater ancestor, while alligators and caimans may have their origins in a freshwater ancestor. Salt glands allow 'true' crocs to travel by sea and live in a range of habitats. Estuarine crocs have the largest range of any croc — they are found from Rockhampton to Burma.

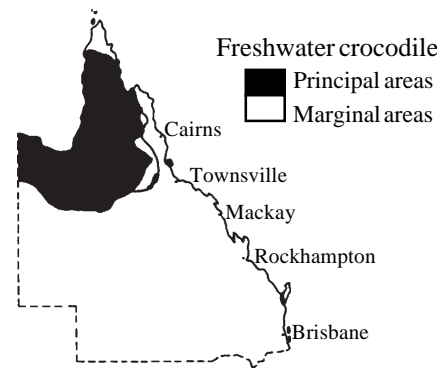
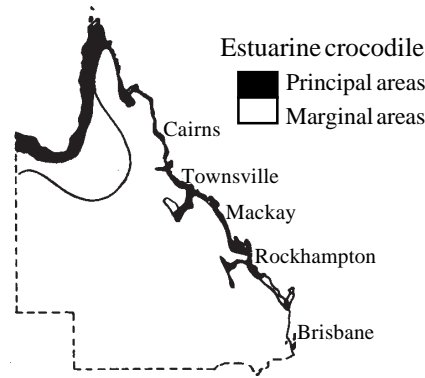
Where are they?

Australia has two species, both 'true' crocodiles. Despite their names, estuarine and freshwater crocodiles can both live in fresh, salty and very salty water. Estuarine crocodiles occupy tidal and non-tidal rivers, swamps and billabongs in a coastal strip between Broome in Western Australia and Rockhampton. Their range can extend quite some distance inland; they have been found about 80km up the Daintree River.

Freshwater crocodiles usually live upstream from estuarine crocs, although the two are found together where territories overlap. Since freshies have sometimes moved into areas where estuarine crocs have been hunted out, it seems that competition from the larger crocs limits their range — freshies are sometimes eaten by large estuarine crocs. However,

freshies tend not to nest on estuaries. Freshwater crocs do not occur naturally in the wet tropics but have been appearing in places such as Lakes Tinaroo and Eacham, presumably because people have dumped them there. This is not a good idea because they pose a threat to aquatic animals such as platypus.

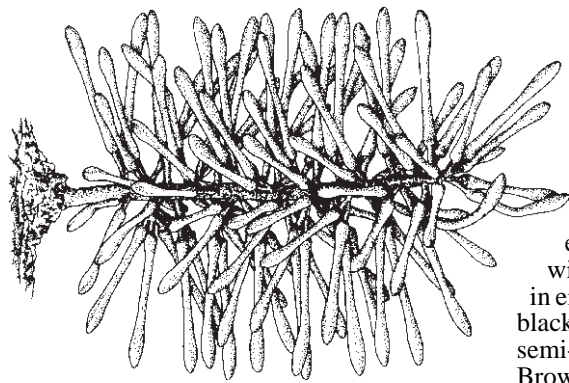
Little is known about estuarine croc territories. However, when crocs are removed from creeks others quickly turn up, suggesting that they move about quite readily. Some regularly move along coastlines while others may appear there while in transit from one river to another. Some with seafaring blood in their veins make quite extensive ocean voyages; estuarine crocs have on occasion been spotted halfway between Indonesia and Australia.



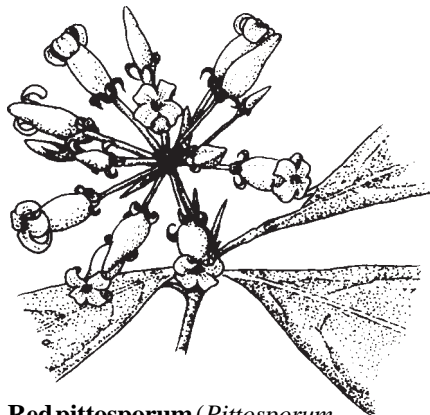
Nature notes

A diary of natural events creates a pleasing journal which grows richer with the passage of time. Watching for the recurrence of an event after noting it in a previous year, and trying to understand what could have caused changes in timing, is intriguing.

These notes are from the author's own notebook, or were offered by researchers and fellow naturalists. Readers will, inevitably, note variations between their observations and those appearing here. If you do not keep a nature diary perhaps this will inspire you to begin one.

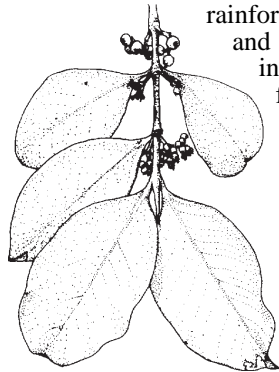


A rare trunk-flowering tree, found on the Main Coast Range, west of Mossman, may put on flowers any time between July and December. The tree has not been given any common name and has not yet received any botanical classification beyond being placed in the genus *Hollandaea*. Spikes of bright red flowers jut from the trunk and branches of this *Hollandaea*. These are followed by pod-like fruit tightly packed with up to eight irregularly-shaped seeds which are liberated when the fruit splits open. As far as is known, this *Hollandaea* appears to be restricted to about three kilometres of hillsides north of Mossman River, where it grows only in a belt between 800 and 1000 metres above sea level.

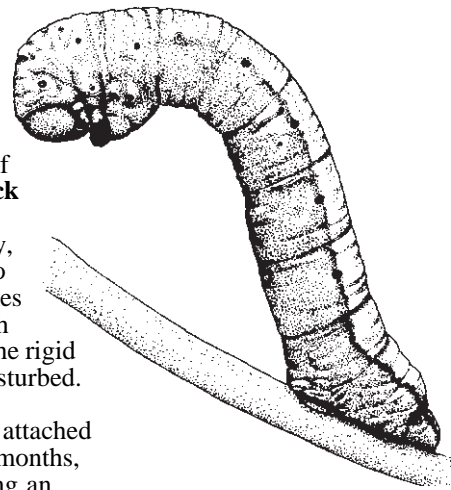
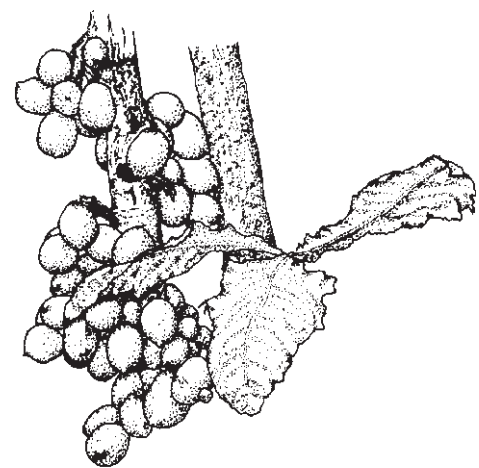


Red pittosporum (*Pittosporum rubiginosum* var. *rubiginosum*) is seen most often as a shrub in rainforest, but can attain the stature of a small tree. Its white flowers and bright fruit are seen in many months of the year, including the mid-winter period. The bright yellow capsules split open to reveal sticky red seeds which attract birds but are quite unpalatable for humans.

Handsome caterpillars of the beautiful **four o'clock moth** may be seen on corkwood foliage in July, even though it is well into winter. This caterpillar comes in either green or yellow, with black dots, and is known for the rigid semi-erect pose it adopts if disturbed. Brown cocoons of pupating caterpillars can also be found attached to corkwood leaves in winter months, these pupae possibly providing an over-wintering generation for this species. Four o'clock moths gain their name through being commonly seen on the wing during the late afternoon. The host plant (*Carallia brachiata*) (below) is an attractive tree found in rainforests and on rainforest margins and wet situations in gallery forests.



The purple hairy-skinned fruit of the lovely **Davidson plum** tree (right) is found in many months of the year, including the mid-winter period. The bright red flesh is hard to ignore, even though taking more than a few nibbles is likely to set most people's teeth on edge. Davidson plum fruit are enjoyed by cockatoos and what they drop is foraged by cassowaries. The ornate foliage of this tree (*Davidsonia pruriens*) is often noticed as a bright pink flush in spring and early summer.



Pink tamarind, an understory tree of the rainforest which often establishes itself on shaded rocky outcrops or rocky creek banks, will probably display ripe fruit this month. The outer capsule of the fruit is about one centimetre long and an unspectacular brown, but when it splits a lovely red aril is seen, enveloping an almost black seed. The aril is recorded as being eaten by rifle birds (*acknowledgments to W.Cooper*) and is probably attractive to many other frugivores. The stem and main branches of this tree (*Arytera pauciflora*) have an attractive angularity which gives the tree an ornamental appearance especially when growing on rugged rock.

A close look at crocs

This page and the next deal mainly with estuarine ('salty') crocs, although much of the information is relevant also for freshies.

The body beautiful

Eyesight is better above water than below it. Underwater, a special transparent eyelid crosses from the side for protection. Croc eyes function best in low light; pupils which are reduced to a slit in daylight open wide and a special layer of light-reflecting crystals behind the retina, common in nocturnal animals, enhances night vision. These crystals cause the eyes to shine red when caught in torch or spot light. Crocs can probably see colour.

A croc's brain is small, about the size of a walnut in a 3.5m animal. It is situated where it can warm up, and function, quickly.

A croc has a keen sense of smell.

A croc's head is one-seventh of the total body length.

Conical teeth give a firm grip. The front two on the lower jaw poke right through holes in the upper jaw bone, and can be felt from above. Teeth are replaced as they are lost throughout most of a croc's life.

The muscles which close the jaws are immensely fast and powerful. However, the muscles which open them seem to be weak; those of even quite large crocs can be held shut with a rubber band.

Ears are small rectangular flaps of skin. A croc's excellent hearing is better than other reptiles, helping it to locate prey.

A crocodile cannot stick its tongue out at you. It is attached to the lower mouth all the way along.

Towards the back of the tongue there are glands which excrete excess salt when the animals are in very salty environments.

Special pits along the side of the jaws contain bundles of nerve endings. Their function is unknown but they may help crocs to locate prey in muddy water.

The tail does the swimming, the pointed, hardened scales increasing its surface area and efficiency. These do not contain bone, but are blood-rich and important for heating.

A croc's 'armour' consists of interconnected scales (scutes), many of them reinforced internally with blocks of bone (osteoderms) seen as raised bumps, highest on the back. These have a good blood supply to help the animal warm up quickly in the sun.

Useful for reversing in water, the back, webbed feet can be brought forward and upwards to propel the animal backwards. They are tucked into the side when it swims or used for balance in water.

Eating habits

As much as 50, even 70, percent of the food which a croc eats is converted to flesh and energy. In humans it is about 3-4 percent because so much (80 percent) is used to produce heat. This means that croc feeding habits are rather different to those of mammals, enabling them to survive for months without eating. In fact, their digestive enzymes cannot work in cold conditions, food rotting in their stomachs rather than being digested.

Young crocs feed on crabs, prawns and shrimps as well as insects which they may jump up from the water to catch. As they reach sizes of 2m they begin to take vertebrates such as fish, birds, water snakes and rats. Larger crocs take whatever they can overpower — sea turtles, goannas, wallabies, dingoes, feral cats and pigs, dogs and even cattle, horses and buffalo. Their keen sense of smell will lead them to walk some distance from water to scavenge carcasses. Humans are too big for crocs under about 2.5m, most attacks coming from animals over

3m in length. Larger crocs will also eat smaller ones — perhaps a population control strategy.

Movement, as well as sound and smell, attracts crocs. Young ones snap at anything around them. When a larger croc spots food on the water's edge it stalks its prey underwater, appearing just at the last minute to take a lunge which may leave it half a body's length up on the bank. Swimming prey will usually be chased on the surface. Crocs have also been observed suddenly swinging their heads and tails into a river bank to trap fish. When opening its mouth a croc can seal the back of its throat with its tongue to avoid gulping in water.

A croc has a relatively small stomach — about the size of a soccerball in a 3m animal — so it may not be able to eat a large prey item entirely. This may begin to rot but that does not mean that a croc prefers rotten food. It may serve to attract fresh prey such as mud crabs, a favourite food.

Crocodiles swallow stones. Collections are found in the stomachs of most large crocs and are thought to help grind up food and, possibly, with balance in the water. Although crocs living in muddy environments seem to thrive without stones, most over 2m in length seem to have managed to pick them up from somewhere.

Although powerful stomach enzymes can quickly digest bone, keratin (for example, hair, turtle shells and insect shells) breaks down very slowly. Hair balls are formed in the stomach and are sometimes found on beaches and estuaries.



ant also for freshies.

The inside story

A crocodile has no diaphragm, the muscular partition between the chest and the abdomen in mammals which is part of the breathing process. To breathe in, a croc has to move its liver and other organs backwards.

Crocodiles are the only reptiles to have a true four-chambered heart, whereas all other reptiles have three. This difference in structure ensures that the blood flow system in crocodiles is more efficient. In addition, crocodiles can control the flow of blood throughout their bodies by increasing or decreasing the heart rate or by 'shunting' the blood flow to areas of importance, such as the heart, brain and muscles, and restricting the flow to non-essential areas like the intestines.

Nevertheless, crocodiles get exhausted quickly. They conserve energy where possible by moving slowly and instead of climbing on to river banks they may rely on the rising tide to lift them up. Quick bouts of energy are used to catch prey. However, because of their relatively small lung capacity they run up an 'oxygen debt' which they 'pay back' later during rest periods. At the time, however, the lack of oxygen results in a build up of lactic acid in the blood. Although crocodiles are better adapted to cope with high blood acid than most animals, sometimes levels rise high enough to kill them. This is the reason why, in the past, very large crocodiles often died during capture. Every effort is now made to avoid this.



Keeping a low profile

When a croc is under the water only the eyes, along with a small part of the top of the head including the ears, and the nose — the main sensory organs — are visible.

Keeping their cool — and warmth

Although commonly referred to as 'cold-blooded', crocodiles need to maintain a body temperature between 25deg. and 35deg. to function efficiently. Unlike mammals which generate their own heat, crocs rely on the sun. When their body temperatures drop they can crawl on to the bank and lie sideways to the sun's rays, giving maximum exposure to their 'solar panels', the blood-rich bumpy scales.

Once they have reached the desired temperature, crocs may need to regulate their body temperature. They cannot cool down by sweating but can slow their heart beat and decrease the flow of blood to their solar-panel scales. They also open their mouths ('gape'), allowing cool air to flow over the only thin skin they have, the inside of the mouth. They may also reduce their exposure by turning to face the sun or move into shade or water.

At night, as air temperatures decrease, crocs often slip into water which has retained its warmth. However, this is not obligatory. Being large animals, their sheer size allows them to conserve body heat, to a certain extent, despite cold external temperatures. In general, crocodiles will more often be seen basking in winter time especially if the weather is cool. Rain lowers the water temperature and cloud cover obliges the animals to bask for longer to accumulate sufficient warmth.

Reproduction — against the odds

The weather in the late dry season, some months before the breeding season, seems to affect subsequent nesting efforts of estuarine crocs. If it was cool and wet with high water levels, breeding increases, whereas hot, dry weather has the opposite effect. Egg-laying begins in late November and continues for six months or more during the wet season.

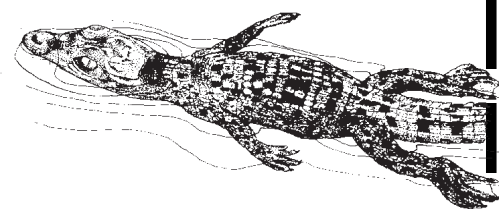
The female estuarine croc builds a mound of vegetation, usually within 10m of permanent water. This helps to keep the eggs above flood levels — embryos 'breathe' through the shell and die if the nests are flooded for extended periods. An average clutch is about 50 eggs, each about 8cm long (about the size of a goose egg).

A gel, which inhibits development, surrounds the eggs inside the mother's body but evaporates when they are laid. This is important because the embryo attaches itself to the top of the egg when it begins to develop and if the egg is then turned the heavy yolk can flop over the embryo and smother it. Since this is likely to happen during the laying process, it is vital that development does not begin until afterwards.

The sex of the hatchlings depends not on a genetic contribution from the parents, but rather on environmental influences, primarily incubation temperatures produced by decaying vegetation of the nest. At 32deg. both sexes are produced but most are male. Higher and lower temperatures result in increasing numbers of females until only females hatch from eggs incubated at temperatures below 30deg. and above 33deg. (Very low or high temperatures kill the embryos.) Temperatures of about 32deg. are considered ideal, producing the best hatchlings. Since these are also likely to be male this gives the boys a head start; males grow faster and eventually to larger sizes.

The female stays around her nest as the eggs develop — never approach a croc nest as the female may be very defensive and potentially dangerous. When the chirping of the babies indicates their readiness to hatch she often digs them out. Adults may even roll the eggs in their mouths to help them open. The hatchlings make their own way to the water or may be carried there in their parents' mouths. Once in the water they stay close to their mother for two to five weeks before beginning to disperse. Little is known about croc movements or territories.

A crocodile must beat the odds to survive to adulthood in the wild. It is estimated that out of 500 eggs only two or three will become adult crocs. Birds of prey, some fish, goannas, long-necked turtles and other crocodiles are among known predators of young crocs but once they have reached maturity their only enemies are each other and humans.



Questions & Answers

Q What are some of the scientific research projects underway at present in the wet tropics rainforests?

A The place to get the details is the Cooperative Research Centre for Tropical Rainforest Ecology and Management (CRC-TREM), based at the Smithfield Campus of James Cook University in Cairns. The Centre provides scientists from five core organisations (CSIRO, JCU, University of Queensland, Griffith University and Wet Tropics Management Authority) with opportunities for collaborative studies of tropical rainforest. This co-operation allows researchers from different disciplines and backgrounds to work together towards common goals. Their results can be passed on to rainforest industries, conservation managers and the wider community.

At the second CRC-TREM annual meeting, held in June, CRC research scientists gathered to discuss results and plans for more than 25 projects. Most of these are grouped in three main programs: **Biodiversity** covers study projects such as plant and animal genetic diversity, freshwater biodiversity, canopy arthropods and the Tropical Forest Information System (TROFIS); **Resource Dynamics** includes projects on disturbance and change, wet sclerophyll forest ecology and management, threatened and threatening species and forest rehabilitation; **Socio-economic studies** covers rainforest tourism and financial models for plantations and agroforestry.

The Annual Report 1993-94 gives an excellent overview of many of the projects being undertaken in these programs. (The 1994-95 report will be available later in the year.) Details of

some research work is also contained in *Tropical Rainforest Researcher*, a newsletter produced every six months.

For more information, or for copies of the 1993-94 annual report or *The Rainforest Researcher*, contact CRC-TREM at PO Box 6811, Cairns, QLD 4870; Tel: (070) 421246.

Q What are the average temperatures for each month in Cairns?

A Average monthly maximum and minimum temperatures (deg. centi) are:

Jan:	31.1	23.6
Feb:	30.4	22.9
Mar:	29.1	21.5
Apr:	27.4	19.8
May:	25.7	17.5
June:	25.5	17
July:	26.4	17.4
Aug:	27.8	18.6
Sep:	29.3	20.4
Oct:	30.5	22.2
Nov:	31.3	23.2
Dec:	31.3	23.2.

Data from *Report on the Cairns Regional Economy*, Issue No 9 February 1995, produced by Cairns Economic Research Unit, JCU.

Q Where do frogs go in the dry season?

A They seek out damp places like trees and holes in logs as well as toilets, shower cubicles, post boxes, drains and washing machines. They leave at night to feed and with the first rains go off to breed.

Facts and Stats on crocodiles

In the wild, female estuarine crocs reach maturity at about 12 years old at a size of 2-2.3m. Males mature at around 3.4m and about 16 years old. This process is much faster in captivity.

The 'normal' maximum size for male estuarine crocodiles is 4.6-5.2m and 3.1-3.4m for females. An 8.2m male was taken from the Staaten River, Cape York Peninsula, in the 1950s. It is estimated that an 8m crocodile would weigh 2300kg.

Growth is fastest in hot and wet times. This creates distinct growth rings in croc bones which can be used to estimate the age of dead animals. One was found to be about 70 years old so it is possible that they could reach 100.

The time between mating and egg laying, in estuarine crocs, is about 4-6 weeks. Egg-laying takes about 30 minutes. Incubation takes about 80 days, varying considerably with temperature. The average weight of an egg is 113g — but this again varies.

Crocs use physical displays and vocal and chemical signals to communicate. Snout-lifting indicates submission.

Crocs have no vocal chords. Growls are made by snorting air through the back of the throat or nostrils. This sounds like an idling outboard motor, probably the reason for many attacks made on boats by the famous male, Sweetheart, in the Northern Territory.

An estuarine croc with a wanderlust turned up on the Eastern Caroline Islands, 1360km from the nearest known population.

The largest crocodilian, known from 70 million-year-old fossils, lived in North America. Its lower jaw was 2m long and its overall body length about 15m, weighing in at over six tonnes. It probably fed on plant-eating dinosaurs called hadrosaurs.

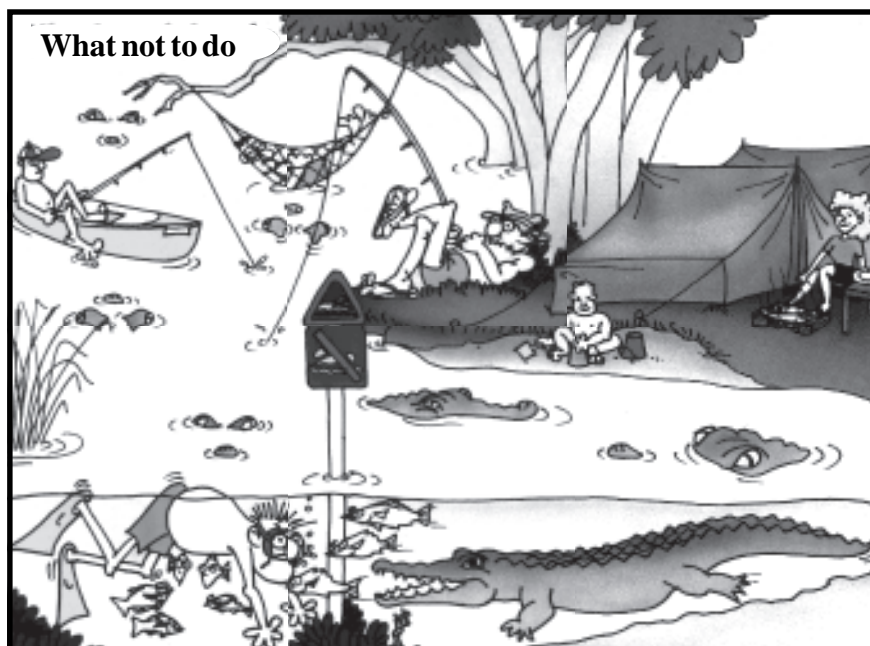
Estuarine crocodiles have been protected since 1969 in Western Australia, 1971 in the Northern Territory and 1974 in Queensland (interim protection in 1972). Freshies were granted protection in 1962 in WA, 1963 in NT and 1974 in Queensland.

All other reptiles have three-chambered hearts but crocodilian hearts, like those of mammals and birds, have four chambers. However, their hearts do also have some useful reptilian features.

Tourist talk

ENGLISH	GERMAN	JAPANESE
crocodile	Krokodil	クロコダイル
jaws	Schlund, Gebiß	顎
teeth	Zähne	歯
solar-heated	sonnenerwärmt	nikko yoku de ata tame rareta 日光浴で暖められた
scales	Schuppen	鱗
oxygen	Sauerstoff	酸素
blood	Blut	血液
attack	angreifen	攻撃する
road accident	Verkehrsunfall	交通事故
dinosaurs	Dinosaurier	恐竜

Don't make a croc an offer it can't resist

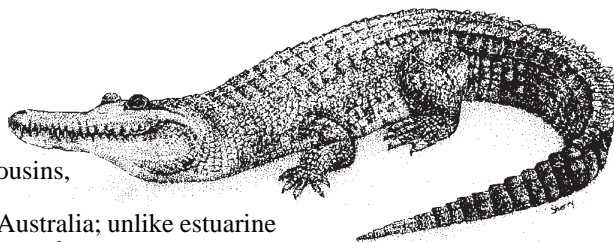


- Obey crocodile warning signs. Just because you don't see any crocs doesn't mean they aren't there.
- Don't go swimming, paddling or wading in areas where there are likely to be crocs. This includes coastal areas and beaches in some places.
- Keep well away from the water's edge in croc territory. Avoid washing dishes and gutting fish on river/billabong banks and be very cautious when collecting water.
- Be cautious when fishing and don't stand in the water.
- Don't share food scraps or fish guts with crocs: they may come back for more!
- Don't sit on branches overhanging a croc creek. Crocs can, and do, jump!
- Don't camp within 50m of water.
- Don't assume because someone else was safe that you will be also: crocodiles are aware of areas regularly used by animals seeking water. Remember you are an animal too!
- Be careful in boats. Crocs can overturn canoes and a foot dangling over the edge may prove irresistible.
- Don't be complacent. Large crocs rarely show themselves and approach very stealthily.
- Adults should supervise children when near water in croc country.

Freshies

In many respects freshwater crocodiles are similar to their estuarine cousins, but there are differences:

- Freshies are endemic to Australia; unlike estuarine crocs they are found nowhere else.
- Freshies are smaller; normal maximum sizes are 2m for males and 1.8m for females although a male of 3m has been caught.
- The jawline of an estuarine croc is irregular whereas that of the freshie is quite straight.
- When moving quickly on land freshies tend to gallop; estuarine crocs don't.
- Freshies feed mainly on insects and fish which their long skinny snouts are ideal for catching. Crustaceans and some small birds, reptiles and frogs are also taken. Humans do not figure on the menu — but freshies can deliver a very nasty bite in self-defence.
- Freshies nest in the dry season, generally in August and September. They are 'pulse nesters', all females in one population nesting within a few weeks of each other.
- Nesting chambers are usually dug in river banks to depths where the surroundings are damp. An average of 13 eggs is laid.
- It seems that *fluctuations* of temperatures rather than the temperatures themselves determine sex.



Commercial attractions

Crocodiles do not often feature in books of farm animals, but the sheer numbers of these animals being produced in captivity in Queensland and the Northern Territory fully justify their inclusion with the sheep and the cows.

Like sheep and cows, crocs produce both meat and skin. The skin of many crocodilian species, when tanned, has an irregular texture and colour because of the osteoderms, the bony 'buttons' in the scales. However, there are no osteoderms in the belly skin of estuarine crocodiles and for this reason it makes the most valuable croc leather. Skins are exported to Japan, France and Singapore but the fairly recent opening of a manufacturing plant in Cairns has seen more finished croc leather products being produced here. Sophisticated equipment allows a designer to enter the plans for a handbag into the computer in Japan. Machinery in Cairns then springs into action to manufacture the object.

In addition, the meat is increasingly finding a market and sells for about \$20 a kilo. Crocodiles are also a big draw card for tourists who want to be guaranteed a close, but safe, look at danger.

Queensland farms breed all their stock from captive animals because collecting from the wild is illegal. In the Northern Territory the situation is rather different. Eggs are collected (by licensed professionals) from the wild, hatched out in incubators and the hatchlings sold on to croc ranches. Landowners are paid \$5 for each egg collected from their land, some receiving as much as \$6000 for doing nothing more than allowing the crocodiles to live and breed naturally. It compensates for the cattle which are occasionally taken and has the effect of making farmers much more positive about having crocs on their land.

The egg collectors take as many eggs as they can find — a total of 10 700 were removed in the last breeding season. Obviously plenty are also missed because monitoring shows that numbers in the wild are actually increasing. In any case, the wet season this year was one of the most extreme since records began and it is thought that all the eggs laid in the wild would have been lost to flooding.

Bookshelf

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

This issue of *Tropical Topics* has relied heavily on this superb book. It begins with an introduction to the crocodilians — the evolutionary history and general biology. It then looks at crocodilian species around the world before concentrating on Australian estuarine crocs and freshwater crocs and their habitats. The final two chapters look at crocodile attacks and crocodiles and man — the relationship between Aboriginal

people and crocs and recent management and conservation. For anyone wanting to learn more about these animals this book is a must.

**Wildlife Management:
Crocodiles and Alligators**
Grahame Webb, Charlie Manolis
and Peter Whitehead (eds)
Surrey Beatty and Sons Ltd (1987)

Most of the chapters, contributed by about fifty authors, were originally presented as papers at an international conference on crocodile conservation and management, held in Darwin in

1985. Of particular interest are chapters on the Management of Crocodiles in Queensland, and in the Northern Territory.

Alligators and Crocodiles
Malcolm Penny
Boxtree Ltd (1991)

Mainly a photo book of crocodilian from around the world, there are some great pics plus sections on biological information, habitat and relationships with humans.



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While all efforts have been made to verify facts, the Department of Environment and Heritage (EPA) takes no responsibility for the accuracy of information supplied in *Tropical Topics*.

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