Don't miss out!
MESA and AAEE Conference
World Heritage Visions and Values
26-30th Sept. 1994
Cairns Colonial Club
Details from (070) 313 747

Interpretation Australia
National Conference
Interpretation Attached to Heritage
Dec. 5th-7th
Charles Sturt University
Albury, NSW
Further information from Stephen Hull, Conference Co-ordinator
Ph: (060) 418 946 / (060) 418 850
Fax: (060) 418 897

Bookshelf

Land Use Patterns and Nutrient Loading of the Great Barrier Reef Region
David Yellowlees (ed)
Proceedings of the workshop held at James Cook University Nov. 1990

The Greenpeace Book of Coral Reefs
Sue Wells and Nick Hanna
Sterling Publishing Co., Inc. (1992)

Taking a world-wide perspective, this excellent book looks at the life of the reefs before quickly moving on to the impact of humans, including a good chapter on Development and Pollution.

Trinity Inlet Management Plan
Plus **Water Quality Guidelines** and **93/94 Annual Report** from Trinity Inlet Management Program

Over and Over
Your guide to recycling in Queensland
Department of Environment and Heritage (1994)
Available from DEH offices

A series of articles on waste reduction and pollution management is followed by a section listing recyclers by name, alphabetically, and indicating what materials they accept. The final section lists materials and recyclers who accept them.

A wide selection of brochures and pamphlets on recycling, stormwater, sewerage, trade waste, etc., are available from DEH offices and from local councils.

This newsletter was produced by the Queensland Department of Environment and Heritage with joint funding from the Wet Tropics Management Authority and the Great Barrier Reef Marine Park Authority.

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Tropical Topics

An interpretive newsletter for the tourism industry

Water quality No. 22 September 1994

Notes from the Editor

The quality of water is affected by whatever is added — suspended sediments, dissolved nutrients and toxic or undesirable contaminants such as heavy metals and pesticides. As urbanisation and agriculture increase there is growing concern about the water surrounding coral reefs throughout the world — an issue which will, no doubt, be raised during a one-hour special insight into the science and survival of the world's coral reefs, to be presented on ABC TV on 28th September.

Produced by the ABC Science and Documentary Unit with support from GBRMPA, ***50 Million Years Under the Sea*** was filmed at locations such as the Red Sea, Florida Keys, Philippines and the Great Barrier Reef. Producer Dr Richard Smith, from Quantum's science series, explores the structure and evolution of some of the world's best known coral reef systems and looks at how they are being managed and conserved for ecologically sustainable development. The program examines threats to the future survival of coral reefs and investigates how research is coming up with solutions by helping us to better understand these unique eco-systems.

Don't miss:
50 Million Years Under the Sea
ABC TV
Wednesday 28th Sept. 8.30pm

The nutrient desert

Ocean currents in the South Pacific move in an anti-clockwise direction, sweeping northwards up the coast of South America before moving westwards until they reach the Australian coast. By that time they are clear, clean and devoid of nutrients. It is under these conditions, sometimes referred to as a nutrient desert, that the Great Barrier Reef has evolved.

How can a complex community of coral reef organisms thrive in water which is almost totally lacking in life? Much of the energy which fuels the system is derived from sunlight by plants (algae), particularly those living symbiotically in coral tissues (zooxanthellae). Needing clear water for photosynthesis, the largely self-contained coral reef system therefore thrives in sediment- and nutrient-poor seas. Enrichment of that water can upset a delicate balance.

Coastal eutrophication — the nutrient-loading of ocean waters — is now a world-wide concern in areas affected by intensive agriculture and urbanisation. Algae, including tiny plants on the water surface (phytoplankton), benefit from high nutrients. Multiplying rapidly, especially if algal-grazers have been overfished, they cut out sunlight, depriving the zooxanthellae, and therefore the corals, of their food source.

In many places reefs are showing signs of degradation. In Kaneohe Bay in Hawaii, one of the best studied of these, a sewage outfall led to algal growth killing the corals. In murkier areas even the algae could not survive and the area was dominated by filter-feeders such as sponges and barnacles which needed no light. When the outfall was moved, however, the process was reversed, the corals eventually reappearing.

It is thought that reefs may be under stress for some time before it becomes apparent. It is uncertain how extensively the GBR has been affected so, in response to the need for exact data, a number of research projects are being undertaken. These aim to evaluate water quality, to quantify additional nutrients and sediments in the water, to trace their origins and to study their effects on the reef. There is a need to discover which nutrients cause what damage. What are the limits to a reef's endurance and what are the early warning signals which could indicate that management of the problem is required? And how best can contamination of ocean waters be controlled? This *Tropical Topics* looks at some of the questions and at attempts to find answers and solutions to the problems.

Marine Parks

Great Barrier Reef Marine Park Authority

Queensland Department of Environment and Heritage

The evidence

Is the Great Barrier Reef actually suffering from increased nutrients in the water?

Much evidence is anecdotal — but reports are persistent. People remember inshore reefs which used to be in much better shape, water that was clearer with less algae. Commercial coral collectors have observed certain species disappearing from particular areas. It appears that changes have been greater on inshore than on offshore reefs, possibly because they are more subject to accumulation of sediment and nutrients as well as freshwater runoff. Researchers are collecting and recording this evidence.

Historical photos can give some idea of changes — although this is limited by the technology available in the past, with the result that most old photos are of reef flats which were exposed at low tide. However, these do suggest that there was greater coral cover in the past.

At least some of the fluctuations in coral cover — and these have been quite dramatic at places such as Green Island — are the result of crown-of-thorns starfish outbreaks. Researchers are still trying to discover if these outbreaks are natural (and possibly of long-term benefit to the reef) or not. One theory for this phenomenon is that high nutrient levels have led to an increase in phytoplankton, the food for COT larvae. These outbreaks, therefore, may be a result of increased nutrient loads — or may mask the effects of these extra nutrients on the reef.

Cores drilled from corals show annual growth rings, similar to those found in tree trunks. A JCU study of these has shown changes which can be dated back about 50 years — coinciding with the introduction of large-scale fertiliser use on land. While there is a lot of natural variation in the system and the connection cannot be proved, the coincidental timing suggests some cause and effect.

Comparisons between results of water tests done at the Low Isles, north of Port Douglas, in 1928/29 and contemporary samples show higher levels of phytoplankton, an indication of increased nutrients. The results of this study, however, need to be treated with caution because water composition can change markedly from year to year. If tests had been done in 1930 they may have shown very different results to the 1928/29 ones.

A large scale water monitoring program, co-ordinated by GBRMPA, began about 18 months ago. Research stations, DEH and tour operators throughout the Great Barrier Reef region are collecting water samples on a weekly or monthly basis from a variety of spots — inshore to outer reef. Temperature, salinity, transparency, phytoplankton levels and weather conditions are recorded and the samples are sent to Australian Institute of Marine Science for further analysis.

AIMS is also carrying out a separate water quality study and monitoring transects, or lines across the reef, so that changes in corals, crown-of-thorns starfish, fish, numbers and types of organisms and so on can be recorded. It is too early to draw many conclusions but over time the bank of data will provide the scientific information so lacking at present.

ENCORE

The *E*nrichment of *N*utrients on a *CO*ral *R*eef *E*xperiment (ENCORE) is a multi-agency project, co-ordinated by GBRMPA, currently being undertaken on One Tree Island, 70km off the coast of Gladstone. Although there is plenty of anecdotal evidence that increased nutrients lead to coral reef degradation, there is little scientific evidence to back this up. This experiment attempts to determine whether concerns for the reef — and associated management action — are justified.

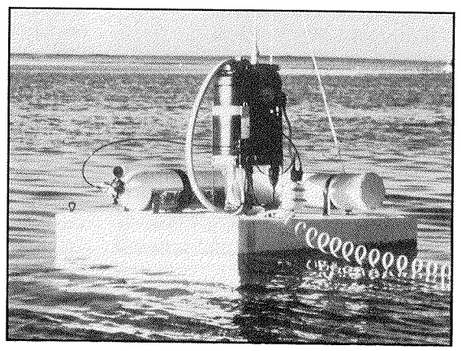
Experiments done in the 1970s showed that the daily addition of nitrogen and phosphorus to a patch reef for eight months resulted in a 25 per cent increase in primary production (total photosynthesis) and a 50 per cent decrease in calcification (skeletal growth). ENCORE aims to test and expand this information.

The reef off One Tree Island has a lagoon with numerous small circular patch reefs known as micro-atolls, twelve of which are being studied. Twice daily, just before low tide, computerised units stationed in nine of the micro-atolls dose them with nitrogen or phosphorus or a combination of the two. The remaining three atolls are left alone to act as a control. This fertilising has been going on for a year and will continue for another year — after which the atolls will be studied for a further year to observe recovery.

One focus of the study is the growth of algae. Which nutrients, if any, stimulate its growth and will it overgrow the coral? It is possible that grazing fish will keep the algae trimmed so certain areas are being caged to exclude them. Another focus is the corals themselves — the effect of nutrients on calcification, on spawning and on the corals' symbiotic algal partners, the zooxanthellae. Too much growth on their part may actually stress and kill the corals. Other studies include the effects on clams, sponges, soft corals, bioerosion and how communities of grazing fish as well as microfauna and micro-organisms react.

So far the most obvious changes have been in corals and clams. There have been tissue changes and reproductive development in corals has been reduced, especially with increased nitrogen. There has been a 45-55 per cent decrease in the calcification rate, of all organisms together, in nitrogen-treated atolls.

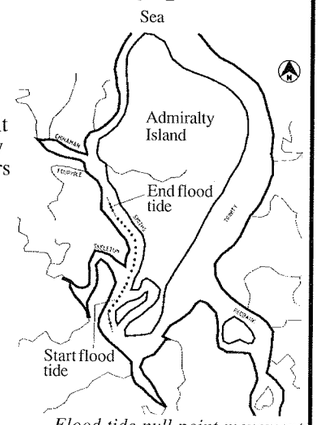
This study will make the effects of nutrients on reef systems more predictable and, hopefully, identify some signs which will give early warnings when water quality is deteriorating — at a stage when damage can still be prevented. This will have important implications for the management of water quality, not only in Australia but anywhere in the world where coral reefs are in danger.



Computerised nutrient dispersal unit, One Tree Island

Trinity Inlet — a very peculiar estuary

Trinity Inlet, leading into Cairns Bay, was once the mouth of the Mulgrave River until it was diverted (probably more than 10 000 years ago) south to Gordonvale. As a result, this large estuary has little freshwater input apart from a few creeks and drains and is dominated by tidal movement.

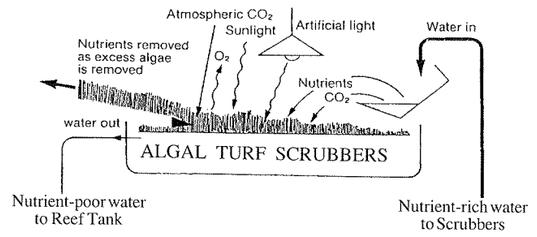


Flood tide null point movement

When the tide rises, most of the water entering the inlet flows into the broader, deeper channel on the eastern side of Admiralty Island. The looped nature of the inlet means that as the water reaches the head of the inlet, it then flows *seaward* through the narrower, western channel (Smiths Creek). The opposite happens on the ebb tide, the force of the water leaving the eastern channel pulling water *up* the Smiths Creek side. The null point — the point where there is a divergence of flow direction — is therefore constantly shifting along Smiths Creek, in response to the tide.

Naturally, these peculiar flow patterns have implications for water quality in the Inlet. These are being addressed as part of the Trinity Inlet Management Plan; a Status Report on Water Quality is being drawn up.

Algal scrubbers clean the system



The Reef Tank at the Great Barrier Reef Aquarium, in Townsville, contains a living coral reef system. Conditions are kept as natural as possible to the point where no food is given to the inhabitants, sun shining through the open top providing the main source of energy to plants at the bottom of the food chain. However, because of display requirements, there is a higher ratio of animals to plants than on a natural reef. For this reason more wastes are produced than can be recycled by the plants. (Dust from the city is an additional source of nutrients.)

To avoid a build-up of nutrients from these wastes, the water is pumped out of the tank and filtered through trays of algae. Several times a minute a tip bucket (right) delivers water on to the tray. The growing algae absorb the nutrients, and the water, now relieved of much of its nutrient content, is returned to the Reef Tank. The algae, with their load of nutrients, are scraped off periodically and discarded.

Artificial lighting at night makes the system more efficient by extending the day length for algal growth. During growth, algae also take up carbon dioxide and release oxygen, making aeration of the Reef Tank unnecessary.

CRC Reef Research Centre

The Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef was established in 1993 to help manage and protect the rich resources of the Reef. The Centre undertakes an integrated program of applied research and development, training and extension, aimed at increasing opportunities for ecologically sustainable development. With particular emphasis on tourism, the Centre provides information for better science-based Reef management and decision making.

The CRC Reef Research Centre is one of over 50 CRCs bringing together outstanding researchers from universities, research institutes, management agencies and private industry. Over $46 million is pledged for the Centre until the year 2000.

Five overall research, education and extension programs are coordinated by the Centre.

1. Regional Environmental Status Program (Leader: Dr Terry Done, AIMS)
Aimed at understanding and controlling water quality, sediment flow, effects of nutrients and pollution, impacts of cyclones, crown-of-thorns starfish and other natural processes on the Reef.

2. Operations Program (Leader: Prof. Helene Marsh, JCU)
Aimed at finding solutions to problems associated with increasing human use of the Reef, particularly tourism and recreational activities.

3. Engineering Program (Leader: A/Prof. Archie Johnston, JCU)
Aimed at developing new engineering practices for the design, construction and operation of Reef facilities and coastal developments.

4. Education Program (Leader: Prof. Howard Choat, JCU)
Aimed at providing scholarships and support for outstanding tertiary students to conduct research into special areas.

5. Extension and Training Program (Leader: Mr Don Alcock, CRC Reef Research Centre)
Aimed at facilitating interactive communication with Reef industry groups, researchers and management agencies and distributing research results.

To become involved please contact:
CRC Reef Research Centre
James Cook University Post Office
Townsville QLD 4811
Tel: (077) 81 4976
Fax: (077) 81 4099
Email: crc.reef@jcu.edu.au

Slime, slick and spawn

As the water warms up a number of natural slicks will appear on the ocean surface.

Most common between August and October, although they can appear at other times, are slicks of a planktonic alga, *Trichodesmium erythraeum*. This alga multiplies rapidly to produce red-brown patches on the surface. Old slicks may be grey or white with a putrid smell.

Accumulations of coral spawn can form pink to white scum-like slicks during the week after the full moon in October to December, persisting for one or two days.

A third type of slick is caused by oil, ranging in appearance from an iridescent surface sheen to tarry lumps.

It is easy to distinguish natural slicks from oil slicks; simply rub some between your fingers. If it washes off with water it's natural and if it sticks it's oil and should be reported immediately. Please call GBRMPA on (077) 818811 or (24 hours) call 016 070 and quote pager number 016 714 252.

Questions & Answers

Q Why do we see Hercules moths only when they come to die in our Mission Beach toilet block?

A Hercules moths are very readily attracted to light. Since Mission Beach rainforest is a relatively intact environment for them, they are regularly drawn to street lights, buildings and toilet blocks. They are very sensitive about environmental disruption and have thinned out or disappeared from many of the other forested areas.

Q While boating in the Whitsundays at the time of a full moon, we observed, at dusk, fluorescent green tubes, about the length of a finger, coming to the surface and then descending again. What were they?

A They were marine worms which have, as yet, not been named. When conditions such as the water temperature, the moon phase and the weather are right they come to the surface to spawn. When the worms are disturbed the increase in their metabolism causes a phosphorescent byproduct which gives rise to the bright green colour. An infrequent and unpredictable event, this worm spawning may be observed anywhere around the Australian coast.

Q Why do blue green chromis (the little damsel fish commonly seen in shoals around corals) change colour and how do they do it?

A Their change in colour from blue to green is a trick of the light. Officially 'a layered crystalline substance creates thin-film diffraction of light which preferentially refracts different colours at different angles' — check your physics books on light-waves to make sense of that! In simpler terms, light is made up of different colours, each of which has a wavelength of a different length. At some angles, some of the wavelengths are bounced back in such a way as to cancel out that colour — which means that another colour will appear more strongly. It's a bit like a CD laser disc with fine grooves which changes colour as you hold it at different angles — just simply a trick of the light!

Q Why do bush thick-knees bob up and down while calling?

A It is thought that they are either displaying for a mate or indicating their territory — or possibly both.

Posters

Which side of the river?
Which side of the road?
Your home is our environment
Three cartoon-style posters are available from DEH offices. Ideal for office walls and classrooms.

Can those butts

A number of people have complained about the growing mounds of cigarette butts discarded around coach parking spots. Not only are these unsightly but they may also pose a risk to wildlife. A tin or other receptacle provided by the driver, along with encouragement to use it, would easily solve the problem.

Butts at sea are another problem. These can be mistaken for food by fish — but then expand inside their bodies causing digestive blockages. Passengers, again, are usually happy to use sand buckets if provided.

Tourist talk

ENGLISH	GERMAN	JAPANESE	
water	wasser	mizu	水
clear	klar	su n da	澄んだ
sediment	sedimente	chin den butsu	沈殿物
nutrients	nahrstoffe	eiyo butsu	栄養物
sewage	abwasser/ klarschlamm	gesui	下水
fertiliser	dunger	hi ryo	肥料
drains	abflusse	haisui	排水
algae	algen	so rui	藻類
reef	riff (korallenriff)	reef	リーフ
sunlight	sonnenlicht	nikko	日光

Facts and stats

A 1992 study estimated that 15 million tonnes of sediment, 77 000 tonnes of nitrogen and 11 000 tonnes of phosphorus are exported to the Queensland coastal zone via river discharges every year. This is approximately four times the load estimated for the entire pre-European settlement period.

Sediment causes problems not only by physically clouding the water and covering organisms such as coral but also by adding natural nutrients, present in soil, to ocean waters.

In general, in urban areas, approximately 500 litres per day per person is discharged into the sewage system. This includes industrial and other uses. This effluent contains approximately 1.5kg phosphorus and 5kg nitrogen per person per year with up to half the phosphorus derived from cleaning agents.

There is a *registered* dog population of 11 140 in Townsville (1990). It is estimated that faeces produced annually contains approximately 70 tonnes of nitrogen — much of which is washed through stormwater drains to the sea. The registered dog population of Cairns is 4 500.

Some coral species, such as those on the inshore reefs, can cope with lower light levels and heavier sediment loads than others. Corals produce mucus which traps the sediment and removes it. This is an energy-intensive activity, however, which cannot be kept up indefinitely.

It has been estimated that during the ebb tide a water volume equivalent to one-thirtieth of Sydney Harbour drains out of Trinity Inlet in the first hour.

WATERWATCH Queensland
A Federal - State Partnership

The quality of our water is an excellent indicator of the health of our environment so the more we know about it the better. **Waterwatch** is a nation-wide program of the Australian Nature Conservation Agency, co-ordinated, in Queensland, by Queensland Department of Primary Industries. It aims to increase awareness and education and to involve local people in building up a national database on the condition of our water. Community groups such as schools, landcare groups, landholders and industry are learning how to test their local rivers, creeks and lakes on a regular basis.

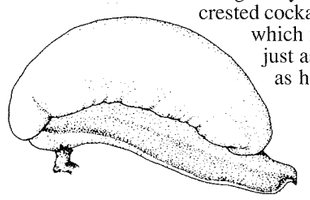
If you would like to become involved with Waterwatch, contact your local QDPI office.

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.

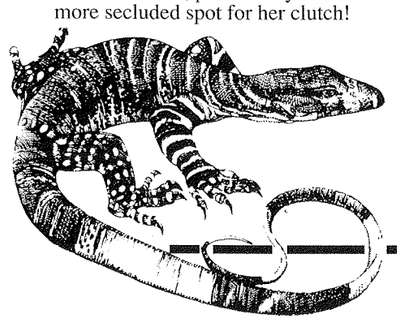
These notes are from the author's own notebook, or were offered by researchers and fellow naturalists. Readers will, inevitably, note variations between their observations and those appearing here. The editor will be delighted to hear your news. If you do not keep a nature diary perhaps this will inspire you to begin one. This column will be enriched by your contributions. Items published will be fully acknowledged.

An extraordinary fruit from a small rainforest tree, known as **buff beech**, should be ripe this month. Looking 'like a maggot on a leaf', a strange white structure grows from a green leaf-like base. The fruit is described by the famous botanist, Bernie Hyland, as a 'green carpel ... with a waxy white succulent ovoid appendage 28-35 x 16-20mm'. This tree (*Irvingbaileya australis*) is restricted to the wet tropics where it is generally a smallish understorey species. The fruit is not edible for humans but is mangled by sulphur-crested cockatoos, which may find it just as curious as humans do.

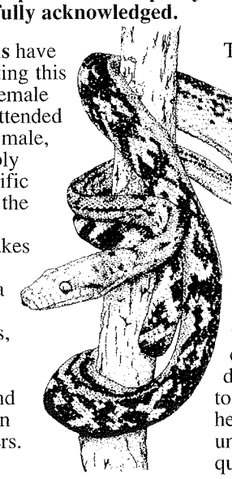


New edition **lace monitors** — which grow to be the largest wet tropics lizards — will be appearing as 20cm babies this month. Lace monitors sometimes use arboreal termite nests for incubators, a decision which must call for quite a bit of co-ordination* on the part of the female who has to climb the tree, excavate a suitably deep and carefully-angled hole into the termitarium, position herself accurately to perform the egg laying, and then hope the termites will build over the intrusion. Six eggs were noted in one clutch. *(Acknowledgments to J.T. Russel, Cairns)*

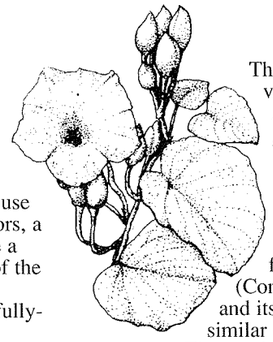
*Charles Barrett, an early naturalist in Australia, gives a remarkable account of a monitor which arrived beside a ground level 'ant hill', made an excavation, deposited several eggs *which it had been carrying in its throat*, and then pushed earth back to cover the eggs. On discovering that she had been watched, the monitor re-excavated the eggs, 'swallowed' them and walked off, presumably to find a more secluded spot for her clutch!

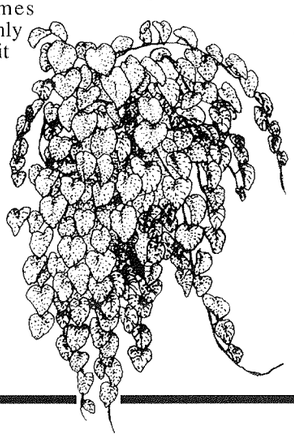


Amethyst pythons have been reported mating this month. A single female in a tree may be attended by more than one male, all of them probably attracted to a specific scent liberated by the receptive female. Clusterings of snakes — presumably all males — around a female is known from other species, including marsh snakes in wet tropics uplands and giant file snakes in northern gulf rivers.

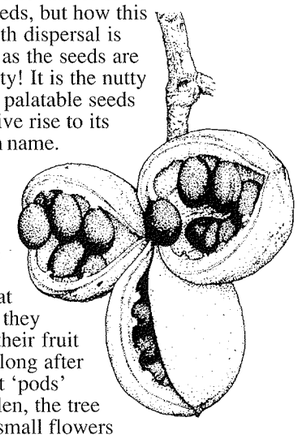


The flowers of a vine known as ***Merremia peltata*** will be in view this month. The plant is a member of the morning glory family (Convolvulaceae), and its flowers have a similar tubular appearance. The petals are white on the inner surface but an unusual silver-grey colour on the outer surface, particularly towards the base of the flower. Leaves are heart-shaped, often over 30cm long and wide. *Merremia* grows so vigorously on the edges of the forest (below) that newcomers to the wet tropics sometimes mistakenly assume it is an exotic.





The very distinctive fruit of the **peanut tree** will be popping open this month. The fruit pods (more botanically, follicles) are carried in groups of three to five on the end of a robust stalk. Each capsule has a greenish-brown slightly velvety exterior, but splits open to reveal a strongly-coloured orange to vermilion interior, with half a dozen shiny black seeds attached to the margins of the pod. It seems certain that the bright display is designed to attract birds to the seeds, but how this helps with dispersal is unclear, as the seeds are quite tasty! It is the nutty textured palatable seeds which give rise to its common name.



Peanut trees are almost leafless at the time they display their fruit but, not long after the spent 'pods' have fallen, the tree puts on small flowers and a new set of leaves. The spent fruits, looking like rotund canoes, lie on the forest floor for months afterwards. This tree (*Sterculia quadrifida*) is a member of the flame tree family — Sterculiaceae.

Gastonia is a rare tree which is currently carrying ripe fruit, at least until the starlings and fig birds storm the trees. Ripe fruits are red to purple, the large crop crowning the tree somewhat like a massive head of umbrella tree fruit. Gastonia is related to umbrella trees and celerywood (family Araliaceae). Its compound leaves and growth habit are rather similar to the latter but in gastonia the structures are significantly more massive. It is known from only a few trees scattered from north of Bloomfield River to Cairns, with several specimens noted in the lowlands between Mossman and Daintree Rivers.

Intruders in the nutrient desert

There is no doubt that nutrients from human sources are entering the ocean. Where are they all coming from — and what, if anything, can be done to reduce them?

It is estimated that a large proportion of the nutrient additions come from **agricultural sources**, notably cane fields. Banana farming, horticulture and mariculture (prawn farms) also produce a share of the nutrients while soil erosion due to cattle farming is a source of sediment, bearing natural nutrients, carried down rivers from higher ground.

The use of fertiliser in agriculture increased sharply from the 1950s to the mid '70s, during which time production per hectare increased up to fourfold. It is recognised that much fertiliser is lost through runoff and drainage and by being converted to gas and escaping into the atmosphere — benefitting neither the environment nor the farmers who pay for it.

NUTBAT (*NUT*rient *B*alance *A*nd *T*ransport from agriculture and rainforest land) is a multi-funded collaborative project being co-ordinated by DPI in Innisfail to find out exactly how most nutrients are being lost and to recommend strategies for reducing those loses. Runoff, drainage and gaseous losses from two cane and two banana sites as well as from two dairy paddocks and a rainforest plot are being monitored. Amounts of added fertiliser are measured and, at harvest, the crops are analysed to quantify how much actually ends up in the plants. A 'budget' can then be drawn up comparing losses and gains. The rainforest plots are included in the study because nutrients lost from these areas, by natural processes, need to be taken into account.

Unfortunately, since the project began 18 months ago, the wet seasons have not been typical so losses from run-off and drainage have presumably been below average. One important finding, however, has been the surprisingly large amount of fertiliser lost into the atmosphere — an invisible and therefore largely unforeseen loss. Urea-based fertilisers are particularly vulnerable when broadcast on the soil surface without significant rain, a loss which could possibly be reduced by drilling the fertiliser into the ground. Types and methods of fertiliser application will be considered and it is likely that other important recommendations will include the optimum times and numbers of times fertiliser should be applied to make sure it ends up in the crop rather than lost from the farm.

Revegetation of creek banks could help reduce amounts of sediment and nutrients entering water courses. While cane farmers may be unwilling to sacrifice productive land for this, cattle farmers generally benefit from clearer water and fewer animals becoming bogged when approaching creeks at unsuitable points.

Stormwater drains carry water which runs off hard surfaces such as roofs, roads and car parks or off land which has been saturated. Unfortunately it carries with it contaminants such as oil, animal waste, fertilisers, sprays, lead, detergents and litter as well as grass clippings, leaves and soil. Ocean Rescue 2000 figures show that oil equivalent to five Exxon Valdez tanker spills pours into the oceans from Australian stormwater drains every year.

Retention areas, included at the land sub-division phase, can trap and remove contaminants. These are present in cities in some southern states but are unusual in Queensland where keeping stormwater clean is largely an individual responsibility.

Which side of the street do you live on? Here are a few suggestions for keeping stormwater clean.

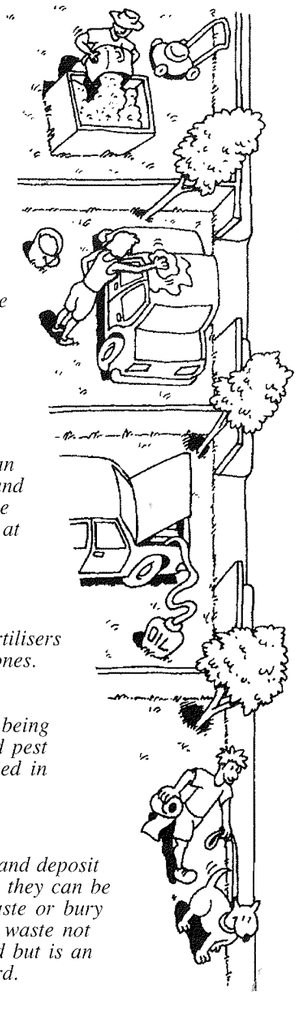
• *Compost grass cuttings, leaves and other clippings with your kitchen waste. The result will improve your garden and keep unnecessary nutrients out of the drain.*

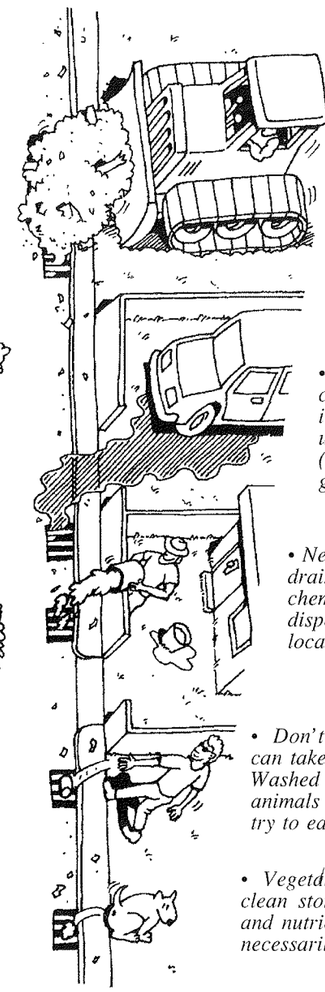
• *Wash your vehicle on the lawn where detergents can be trapped in the grass.*

• *Waste (and cooking) oils can often be recycled (see Over and Over, Bookshelf) or should be disposed of in special drums at the tip.*

• *Be sparing with garden fertilisers and sprays and avoid toxic ones. Fertiliser applied during moderately rainy spells will penetrate the soil instead of being washed away while weed and pest sprays are usually best applied in dry weather.*

• *Scoop that poop — collect and deposit pet wastes in the toilet where they can be treated along with human waste or bury them in your garden. Animal waste not only adds to the nutrient load but is an ugly and smelly health hazard.*





• *In urban areas much sediment is added to the stormwater by construction activities. Hay bales staked across drains can filter out sediment while retention ponds at the bottom of the site can trap a large amount. It is also important for exposed soil, especially on hillslopes, to be stabilised with vegetation as quickly as possible. It would also be sensible to carry out most excavation work during the dry season.*

• *Use unleaded fuel and keep your car engine well-maintained so that it doesn't leak. Place cardboard underneath to absorb any spill. (This can then be placed in the garbage.)*

• *Never pour waste chemicals down the drain. Many solvents and other chemicals can be recycled or should be disposed of specially. Contact your local council for advice.*

• *Don't drop litter. Plastic, in particular, can take a very long time to degrade. Washed into the ocean it can kill marine animals which are trapped by it or which try to eat it.*

• *Vegetated drains and creeks can help to clean stormwater by trapping sediments and nutrient matter — 'tidy' drains are not necessarily the best.*

Sewage consists of human, domestic and licensed industrial waste and is made up of 99 per cent water and one per cent solid matter. Most is submitted to secondary treatment after which sludge is stockpiled at the sewage treatment works while effluent is usually discharged into waterways and ocean. Present systems do not generally remove nutrients such as phosphate and nitrogen which means that the effluent is nutrient-rich and therefore liable to promote plant growth such as algal blooms.

A number of alternatives are being looked at. Upgraded secondary treatment plants are beginning to remove more of the nutrients. The remaining effluent is increasingly being used to irrigate golf courses, beef pastures, cane lands and so on instead of being dumped into the sea. This tends to be a better option in drier areas such as Townsville where irrigation is required for much of the year. Another option is the use of specially constructed wetlands where nutrients are absorbed by vegetation.

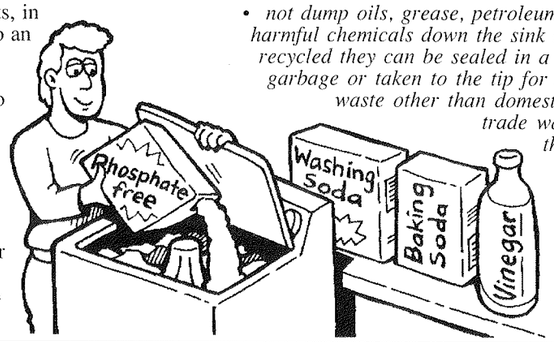
Concern over discharge from island resorts, in such close proximity to the reef, has led to an upgrading of treatment where raw sewage was previously being dumped into the sea. Now, on most islands, it is being treated to secondary standards, the effluent being used to irrigate golf courses and gardens. Green Island now boasts one of the few tertiary treatment plants in Queensland. Water from this system, which has been disinfected with UV irradiation, is reused for flushing and irrigation and is stored for fire fighting. Sludge is stored and barged to the Cairns sewage treatment plant twice a week.

Remember that whatever you put down the sink ends up in the sewage and affects the quality of the effluent entering our waterways and ocean. In order to cut down on harmful loads in sewage you can:

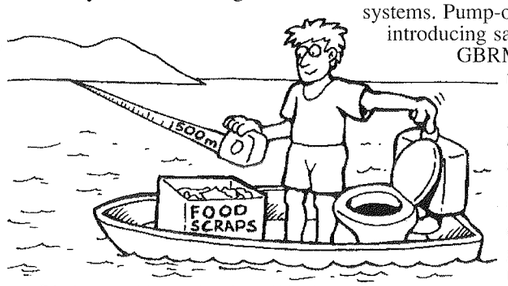
• *use phosphate-free detergents. It is estimated that this would reduce the phosphate load by half. Environmentally-friendly cleaning alternatives such as vinegar and baking soda can be just as effective as commercial brands.*

• *not dump oils, grease, petroleum waste, acids and other harmful chemicals down the sink or toilet. If they cannot be recycled they can be sealed in a container and put in the garbage or taken to the tip for special disposal. Any liquid waste other than domestic sewage is defined as trade waste and is controlled, through a system of permits, by local councils.*

• *compost your food scraps. Putting them down the sink, via insinkerators (garbage guzzlers), overloads the sewage system.*



Ideally **marine waste** generated at sea should be brought back to land and diverted into appropriate garbage disposal or sewage systems. Pump-out facilities, however, are limited at the moment and there is a problem with introducing salt-water waste into freshwater sewage systems. In the absence of better options, GBRMPA guidelines state that holding tanks must be discharged at least 500m from the reef edge.



Discharge holding tanks at least 500m from the reef edge

As numbers of visitors to the reef increase, it may be necessary to impose limits on the discharge of sewage by vessels. For example, yachts without holding tanks are allowed to stay in Sydney Harbour for only a limited number of days.

*Suggestion: If it is impossible for you to carry food scraps back to land you could deposit them with the sewage. The illegal practice of dumping scraps, in the guise of fish feeding, is still going on. Not only does this inappropriate diet harm the fish (see *Tropical Topics* 10) but it also adds extra, potentially harmful nutrients to the water right on the reef sites.