Tropical Topics

An interpretive newsletter for the tourism industry

Butterflies and moths

No. 54 April 1999

Notes from the Editor

Throngs of birdwing butterflies are to be seen at the moment in the vicinity of *Aristolochia* vines*, the bright green male and the enormous female (Australia's largest butterfly) often flying in mesmerising synchronicity. Anyone who has taken the simple step of planting these vines* in their garden or resort is likely to be treated to this sight — one which visitors may well count as a highlight of their visit to the Tropical North of Australia.

Growing the food plants of butterflies and moths is a particularly rewarding pursuit (see page 7). Not only does it attract the colourful adults, but provides opportunities for watching the growth and development of the caterpillars — and the antics of their enemies. Pupae, if handled carefully, can be brought inside so that the adult can be admired as it emerges. Simply hang the pupa out of direct sunlight, spray from time to time to moisten it and when the adult has emerged leave windows open so that it can find its way outside when ready to fly.

*Only native birdwing vines will allow the birdwing butterflies to reproduce — imported South American Dutchman's pipe vines attract the female butterflies to lay eggs, but kill the caterpillars. Plant *Aristolochia tagala*, or *Pararistolochia deltantha* NOT *Aristolochia elegans* or *A. ringens.*

I would like to thank Mike Trenerry, EPA, and Sue and Jack Hasenpusch, Australian Insect Farm, for their valuable help with this issue.

Not a butterfly

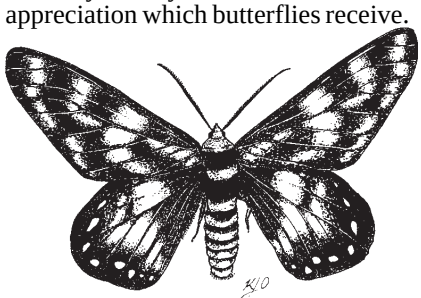
"What is this butterfly?" This query is often directed at Queensland Parks and Wildlife staff. Invariably the insect in question (right) has large wings patterned with bands of black and pale blue which is often tinged with a coppery blush. It has been seen fluttering around flowers but cannot be found in any of the Australian butterfly books or butterfly posters.

The reason is simple; it is not a butterfly, but a moth — the appropriately-named day-flying (or zodiac) moth. So what makes this insect, which looks and acts like a swallowtail butterfly, a moth?

There are two main distinctions. All butterflies have antennae with club-shaped ends while those of most moths are feathery or pointed — although some moths with clubbed antennae break this rule. In addition, while many moths possess a device (frenulum) to lock the wings together in flight, with one exception* this is not found in any butterflies. Butterflies, therefore, have clubbed antennae and lack frenulums.

The similarities between moths and butterflies, however, are more striking than their differences, the name of their order — Lepidoptera — which means 'scale wings', describing a unique characteristic common to all members of the group. In fact butterflies are just one of many groups within the order, just as owls and parrots are all birds. Nevertheless, many people who consider butterflies a delightful asset to the garden, view moths as pests, to be exterminated. While a few species certainly are a nuisance, their larvae feeding on clothes, stored grains and crops, the vast majority of moths are completely innocuous. Indeed, many are important plant pollinators and a few have been put to good use, one species having devastated weedy invasions of prickly pears and another being used (along with weevils) in the fight against water hyacinths.

Of the estimated 22 000 Lepidopteran species in Australia, only 385 are butterflies, leaving about 21 615 moths! They range from the huge Hercules moth to the thousands of tiny 'microlepidoptera', most of which have not yet received names. A glance at a moth book (see Bookshelf) will reveal how diverse and how lovely these insects can be. They are certainly worthy of the sort of appreciation which butterflies receive.



*The **four o'clock moth** (above) is another bright day-flying moth, frequently mistaken for a butterfly. It has a fat yellow body and attractive very dark purple wings interspersed with scaleless, transparent 'windows' and bright yellow spots on hindwings.*

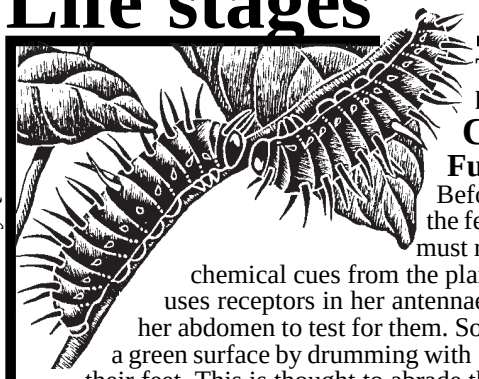
**The male regent skipper (found in the Wet Tropics) is the only butterfly to lock its fore and hindwings together during flight — which makes it the most primitive of the world's butterflies. The females, however, are more advanced — they have lost their frenulums!*

WET TROPICS MANAGEMENT AUTHORITY

QUEENSLAND GOVERNMENT Environmental Protection Agency

Life stages

Native Aristolochia tagala *vine and birdwing caterpillar illustrations courtesy Queensland Museum*



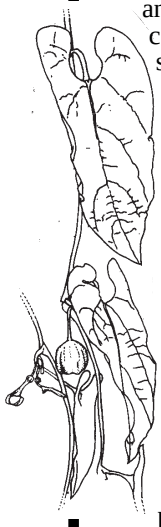
The life cycle of the butterfly is a miracle of nature which is introduced to us all early on in our primary school careers — but details of the transformations involved still puzzle scientists.

Crawling eating machines

Fussy feeders

Before she lays her eggs, the female butterfly or moth must receive the correct chemical cues from the plants she lands on and uses receptors in her antennae, legs and the tip of her abdomen to test for them. Some females respond to a green surface by drumming with their feet. This is thought to abrade the leaf enough for the essential oils to be released and its suitability for egg-laying assessed. Temperature, colour, light, shade and leaf texture may also be important while low or high air pressure are known to influence egg-laying. Numbers of eggs laid by individuals vary from 120 to several hundred.

Most butterflies are very limited in the variety of plants which they consider suitable for their offspring, and the few chosen by each butterfly species are likely to be related. This is why some introduced plants, which apparently give the correct signals, are rapidly adopted (for example, the orchard butterfly on citrus, the common Australian crow on oleander and rubber vine). This can lead to some unfortunate mistakes, however. Blue triangle butterflies sometimes deposit eggs on young shoots of avocado, Eichhorn's crow on frangipani and birdwings on non-native *Aristolochia* vines — but their caterpillars do not survive. On the other hand, the orchard swallowtail has been tricked, experimentally, into laying on parsley, celery and camphor laurel instead of citrus trees and their caterpillars have thrived — even growing more rapidly on the parsley. It appears that the female's instincts are not always correct.



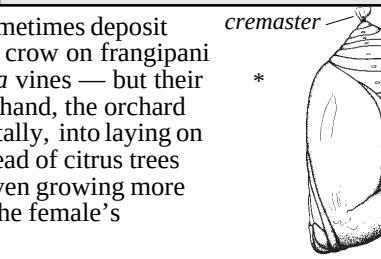
Whether the 'wrong' plants poison the caterpillars is not certain. The caterpillars themselves are fussy eaters, having an inbuilt preference for certain types of food — to the point where paper treated with the appropriate plant juices will be consumed. They appear to be able to test the plants with antennae and certain parts of their mouths and if they detect the wrong food they refuse to eat it. However, when these mouthparts and antennae were removed experimentally, some caterpillars ate, and developed successfully, on plants they normally reject. Many chosen foodplants are extremely toxic, but the poisons may simply be passed, unchanged, through the gut, rendered non-toxic or stored for use in self-defence (see page 5).

Feeding machines, caterpillars can, in just two weeks, grow to 3000 times their original weight — the equivalent of a human ballooning to the size of a small elephant in the same period. It pauses only to shed its skin as it gets too tight, the number of costume changes depending on species but usually numbering about five. (Females may moult one more than males.) It has been shown that the eyes of some caterpillars are able to distinguish shape and limited colour — yellow and green stimulating feeding and blue and red having the opposite reaction. Behind the head of the caterpillar, the three-part thorax has six pointed legs. Further along the abdomen is a serious of stumpy legs used for hanging on. If pressed on to a smooth surface they can work as suction cups but they also have tiny clinging claws.

Unusual foods

While living plants are the most normal caterpillar food, some species (particularly moths) eat dead wood, leaves and bark, stored seeds and cereal, animal dung, wool, hair, feathers, other insects and each other. Among the plants, fungi, lichens mosses, cycads and even certain ferns* are targeted by a few species. Many caterpillars eat their own eggshells as their first meal although, since the proteins are indigestible, the benefit of this is not fully understood.

*Ferns are generally avoided by caterpillars — possibly because they contain a chemical similar to the moulting hormones of insects which could interfere with their development.



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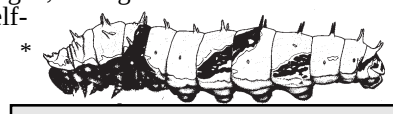
Change of life

When the caterpillar is ready to pupate it usually spins a silken pad for support. This is a particularly vulnerable time from the point of view of parasites, when it has slowed down but still has a soft skin instead of the harder pupa. Many are stung by wasps, their young developing inside the pupa and eventually emerging instead of the adult butterfly or moth.

Although some butterflies (and moths) pupate in underground chambers most hang from twigs or leaves. Two types of pupa (or chrysalis) are produced. Some species (swallowtails, whites, yellows, blues, coppers, and some skippers) produce a girdle which is looped around the upper part of the caterpillar and provides support as its split skin is cast off. Special claspers (cremaster) or anal hooks at the end of the abdomen are then hooked into the silken pad, to hold the pupa secure. Other species simply hang upside down from the cremaster (which requires some fancy footwork when the skin is slipped off). A number of moths enclose their pupa in silken cocoons — the silk moth taking this to extremes.

Within the pupa great changes are taking place, out of sight. When the caterpillar was originally forming inside the egg, two types of cells developed. Some formed clusters and ceased developing, while the others divided normally to produce the body of the caterpillar. After it hatched, these cells grew and enlarged as the caterpillar did, growing to many times their original size, while the cell clusters remained unchanged and unfunctioning. When pupation starts, however, the distended caterpillar cells break down and the cluster cells come to life. Nourished by the soup formed by the breakdown of the other cells, they divide rapidly to form the adult body.

When the adult butterfly or moth is ready to emerge, the pupa may become darker or transparent, the insect eventually appearing usually during the hours of darkness. Following a shaking of the pupa, the head pushes its way out of the end. Gradually the entire body emerges, the wings folded and crumpled. The adult must then hang as blood pumps along veins in the wings and they unfold. The veins and wings are soft but gradually the blood is withdrawn into the body again and the veins harden into rigid structures which support the wings.



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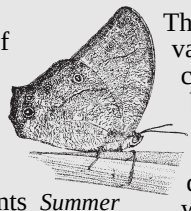
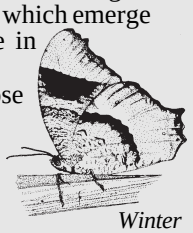
Colours

The wonderful colours and patterns of many butterfly and moth wings are produced by numerous tiny scales, which overlap like tiles on a roof. The wings of a large butterfly may hold a million and a half of these scales. Some are simply coloured with pigments but many are structured so that they split light and produce an iridescent sheen. Transparent ones on top of coloured ones give a soft, velvety or metallic effect while a complete lack of scales on parts of the wing can produce a transparent effect, as in the big greasy butterfly or the 'window panes' on the wings of the four o'clock moth.



Summer

The colour of some butterfly wings vary according to weather conditions. Those of evening brown butterflies which emerge from their pupae in summer are quite different from those which emerge in winter (June to September, roughly).



Winter

The colour of the upperwing of the female purple azure butterfly seems to be affected by humidity; those from Townsville are bluer while those from the more humid Cairns area are more purple.

 *Illustrations marked * reproduced courtesy CSIRO from* The Insects of Australia

Winged adulthood

Whereas caterpillars focus on little other than food, adult butterflies and moths have their minds firmly on sex.

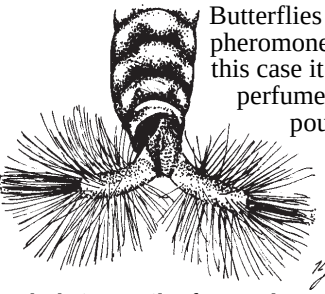
Apart from a search for the occasional snack, adult butterflies have eyes only for each other. Generally it is the males which do the hunting — and have slightly larger eyes through which they keep watch for the appropriate colour, shape and size.

Some males, such as birdwings, simply frequent the larval food plants waiting for females to appear. They may even pounce on females which have just emerged from the pupae, mating with them before their wings have completely dried.

Others having special trysting spots. Males of many species — skippers, swordtails, triangles, jewels, and azures — congregate on the tops of certain hills. Some patrol the area while others adopt perches which they defend vigorously, challenging other males which fly near. If one is removed it is quickly replaced, an indication of the popularity of certain perches. The hill top attraction is not a source of nectar or even larval foodplants, since they are usually absent, but virgin females, fresh from their pupae, which visit the area specifically for mating. With little time to be wasted in looking for a mate, this system is an efficient energy saver.

The xanthomera skipper is a frequent 'hilltopper'.

Odour is an important cue for nocturnal insects and many female moths produce a strong pheromone which can be detected by the feathery antennae of the males as much as 11 kilometres away; at this distance there would be as little as one molecule in every cubic metre of air. When the males have followed the scent to its source they too produce pheromones which may encourage the female to mate.



The hair-pencils of a crow butterfly

Butterflies also produce pheromones — but in this case it is just the males which put on the perfume. It is produced in modified scales or pouches on the wings, structures on the abdomen or on a bundle of hairs which can be extended from the tip of the abdomen. Known as 'hair-pencils', these are generally covered with a dust-like scented powder which is sometimes applied to the brushes when the male inserts his hair-pencils into the patches or pockets on his wings. The dust acts as an aphrodisiac on females of the same species. When a male encounters an appropriate female he flies above her, raining his 'love-dust' on to her and sometimes attempting to brush her head and antennae with his hair-pencils. As a result a receptive female often settles and mating proceeds.

The chemicals from which the pheromones are manufactured are not present in the caterpillar food plants or in adults which have just emerged from their pupae. Instead the males must obtain them by feeding on the correct plants.

After mating the males of big greasy and glasswing butterflies ensure paternity of the offspring by depositing a special substance over the female's genitalia. This hardens to form a type of 'chastity belt' which prevents further mating.

Snacking

Some adults do not have mouthparts to distract them from their primary task of finding a mate. Others sip only a little sugar and water (they are unable to digest fats or proteins) obtained from nectar or fermenting fruit juices. They have sensitive chemoreceptors on their feet which have been shown capable of distinguishing between subtle differences in strengths and types of nectar solution. This food is used to fuel flight, mating and egg production.

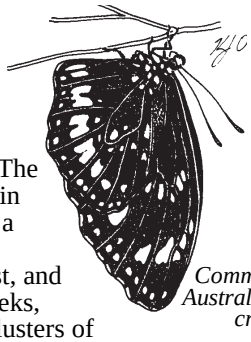
Eye spy, butterfly

Made up of many lenses, an adult butterfly's eyes are a vast improvement on those it possessed as a caterpillar and are particularly sensitive to movement and colour. Experiments with paper flowers have shown that certain butterfly species prefer blue to purple and yellow to red, ignoring green until they were ready to lay eggs. At least some species are able to see ultraviolet; when viewed in this light, the wings of some male white butterflies, can be seen to have iridescent patches which are invisible to us but presumably play an important part in courtship.

Skippers — a large family of 122 species in Australia — tend to be small and brown or yellow. They are rapid flyers which frequent grasses, their caterpillars feeding, hiding and pupating in tubular shelters made from rolled leaves. The orange dart, uniquely, rests with its forewings held up but the hindwings spread flat.

On the move

Wanderer butterflies are famous for their north American migrations where, known as monarchs, they travel vast distances and aggregate in spectacular numbers. The wanderings of this butterfly eventually brought it across the Pacific to Australia by late last century after its larval food plants were introduced. Old habits die hard and overwintering clusters have been observed in southern Australia.



Common Australian crow

There are migration records for about 30 species of Australian butterflies, although only 10 do so regularly. Brown awls, a type of skipper, migrate in their thousands, spending the winter in north-east Queensland and moving south in summer. The next generation makes the return trip north in late summer. During winter, a number of Wet Tropics butterflies move to the coast, and to sheltered areas along creeks, where they congregate in clusters of hundreds or even thousands for three months or more. Blue tigers and common Australian crows (which are related to the wanderers/monarchs) are the most noticeable but they may be joined by black and white tigers and eastern brown crows. They hang from twigs waiting for temperatures to rise and new leaves to appear on larval food plants. Yellow and lemon migrants, as their name suggests, also move in large numbers.

Zodiac, or day-flying, moths can sometimes be seen in large numbers in winter, aggregating at night. It is thought that they may be heading to the Bartle Frere/Johnstone River area to breed. The adults disperse in summer, large numbers having been seen in some years in December on the Atherton Tablelands.

Suspended animation

Migrating adults generally do not eat, having built up sufficient fat reserves during their caterpillar stages. Their hormones are also 'switched off' which means that they do not mate and are not bothered by territorial aggression which would make it difficult for so many to live so closely. Butterflies are able to go into a form of hibernation at any stage — egg, caterpillar, pupa or adult. Growth, below a certain temperature (which varies with species) may cease, only to resume when the temperature rises again. Drought and lack of food may also cause development to cease, as can shorter days. If dingy, orchard and canopus swallowtail caterpillars are exposed to less than 14 hours of light per day, no matter how warm it is, development pauses at the pupae stage. The fivebar swordtail butterfly, which frequents deciduous vine forests, flies only in summer. It rests in its pupa for the remainder of the year, emerging in response to summer rains.

If a butterfly is too cold to fly (20deg. is about the limit) it may flap or vibrate its wings to warm up. Overheating can also be a problem, particularly in the tropics, so many species fly or rest in shade and when they land hold their wings upright so that they partially shade the body.

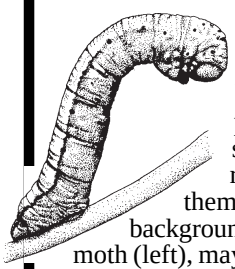
Defence strategies

Butterflies, moths and their caterpillars are an important part of the food chain, providing tasty snacks for many other animals, from birds, bats and reptiles to invertebrates such as spiders. Many are parasitised by flies and wasps whose young feed on eggs, caterpillars and pupae. However, some must make it through to adulthood to produce the next generation — and use some intriguing strategies to get there.

Undercover caterpillars

Many caterpillars and moths operate under cover of darkness, hiding away during the day. Alternatively, a number of caterpillars create cover for themselves by joining adjacent leaves together or by folding or rolling leaves and securing their homes with silk. Small caterpillars (leaf miners) may tunnel inside their foodplant leaves while larger ones, such as the witchety* grub, (a wood moth caterpillar) burrow deep into wood and roots. Caterpillars of the Australian plane butterfly live in the fruits of the lolly berry vine (*Salacia chinensis*), eating the seeds.

*The original 'witchety grub' is the larva of the wood moth *Xyleutes leucomochla*, which lives in acacia roots in inland South Australia. The term is now used widely for many edible wood-boring caterpillars and beetle larvae.



Camouflage is frequently employed. Green caterpillars vanish against a leaf background and some moths merge wonderfully with their background when they land on bark and lichen, pressing their wings down flat to eliminate shadows. Some have tufts of scales which resemble rough bark and are able to orient themselves so that their markings match those of their background. Looper caterpillars, such as the four o'clock moth (left), may stand up at an angle, looking like a twig, or may adopt a curved position, resembling the missing part of the leaf which vanished into its mouth the night before. Case moths create special silken portable sheaths (right) on which small sticks and other materials are glued. They travel with these 'shells' around them — sometimes turning up on the outside walls of houses or on fences — and eventually pupate within them. Some female case moths do not develop wings and never leave their shelters, the males visiting them for mating.

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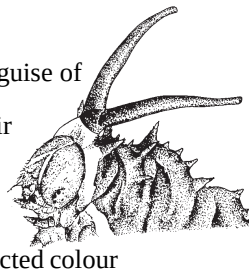
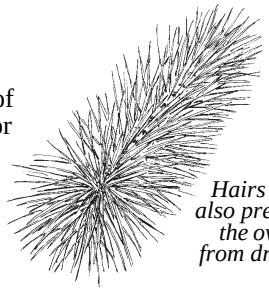
* Young orchard butterfly caterpillars, and certain moths, rather than merging with their background, pass themselves off instead as bird droppings, which they resemble in both form and colour.

Smelly surprises



If a predator penetrates the bird-dropping disguise of the orchard butterfly caterpillar it is in for a surprise when suddenly confronted with a pair of bright red horns which pop up from the creature's head. All swallowtails (birdwings, Ulysses and so on) are able to perform this trick when disturbed. The 'horns', known as osmeterium, not only shock with their unexpected colour (which varies from pink to yellow and orange) but produce a strong odour which presumably also acts as a deterrent as the caterpillar waves its head at the source of the disturbance. Since birds are particularly sensitive to the colour red, it may be designed to repel them, but the smell is thought to also repel insects and act against potential parasites such as wasps. Some moth caterpillars also have pop-up osmeteriums, sometimes producing formic acid as well.

Hairy horrors



Hairs may also prevent the owner from drying out.

The stinging hairs on the caterpillars of some moth species, notably the bag, or boree, moth, create another effective defence, the toxins in the hairs causing pain and itchiness. While this no doubt repels many birds, cuckoos and cuckoo shrikes seem to be immune and feast happily on these larvae. Many of these caterpillars congregate in a silken fortress in, or at the base of, a tree — a formidable defence since the cast off skins and hairs permeate the bag. Hairy caterpillars may move, en masse, in a long snake-like procession which may just be mistaken for one by potential predators.

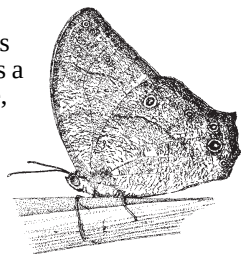
Bungy escape

Some caterpillars, when disturbed, simply drop out of sight — literally — using a silken thread to lower themselves below the foliage until the coast is clear and they can return to base. Others wriggle wildly and attempt to strike predators and parasites.

Some moths can avoid capture in spider webs and on sticky sundew traps by sacrificing some of their scales — a loss which does not affect their ability to fly.

Vanishing butterflies

The Australian leafwing butterfly is named for its imitation of a dead leaf, the projecting part of its hindwing looking like a stalk while a dark vein running across both fore and hindwings resembles a leaf's midrib. Although orange above, this species clamps its wings shut when it settles in shade, instantly becoming a 'dead leaf'. The evening brown (right) also merges well with the dead leaves on which it frequently settles while many blues perform perfect disappearing acts, the pretty colours of their upper wings vanishing as soon as they settle and close them, to expose just the dull underwings.



Shock tactics

If camouflage fails, and a predator is about to take a bite, many adult moths and butterflies as well as the caterpillars have a surprise up their sleeve. Bright colours and/or patterns, suddenly revealed from beneath a moth's dull upper wings at the moment of flight, may cause a startled predator to retreat.

Large eye spots, especially if they also make a sudden appearance and open and close as the insect flies, can cause the attacker to consider its own safety — has it disturbed a sleeping owl or, in the case of an eye-spotted caterpillar, a snake? The eye-spots on some caterpillars are hidden in a crease in the skin unless it is disturbed. Alternatively, spots may serve to attract an attack to a part of the wing, or the tail end of the caterpillar, enabling its owner to escape with less than fatal damage.

Pupae (cocoons and chrysalises), being stationary, are vulnerable to attack. The tough casing provides some protection and most are extremely well camouflaged but in addition to this many are surprisingly capable of animation — twitchings, often accompanied by clicks and rattles, created by contractions of the abdomen.

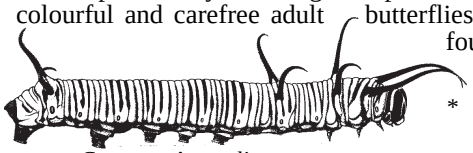
The noises are produced when certain abdominal segments, equipped with special ridges, are rubbed together or against ridges within the pupa. Since this is usually a response to the pupa being touched, it is presumably a strategy for startling predators. Clicking, however, is particularly common in species which are attended by ants (see right). Probably it attracts them, eliciting defensive behaviour on the pupa's behalf — or the pupa may act as an alarm bell, alerting the ants to intruders.

*Illustrations marked * reproduced courtesy CSIRO, from* The Insects of Australia

Chemical weapons

In contrast to those butterflies and moths which rely on camouflage, the bright wings and colourful stripes and adornments of many species would seem to invite predators. Most predators, however, know better. They know that red (along with orange or yellow, combined with black) means danger.

A disproportionate number of caterpillar food plants contain toxins. It is thought that while the plants were evolving toxic defences against being eaten, the butterflies were evolving alongside, developing resistance and turning the chemical weapons to their advantage. Retained through the process of metamorphosis, the poisons serve not only the caterpillars, many of which demonstrate their unpalatability with bright stripes and spines, but also the colourful and carefree adult butterflies. (The toxins are also found in eggs, as well as in some wasps which have parasitised certain moth caterpillars.)



Common Australian crow

Observations of adult wanderer butterflies have shown that the toxins they have acquired from milkweeds — a type of heart poison which affects vertebrates — will quickly cause a bird which attempts to eat them to vomit. It does not necessarily die, but lives to remember and not repeat its mistake. Interestingly the poison is most concentrated in the wings and is thus quickly discovered by a bird as it begins an attack.

Many tiger moths can pre-empt an attack by producing, with a sizzling sound, a pungent, toxic frothy substance from the sides of their heads while certain moth caterpillars spit repellent liquid at enemies. This liquid is extracted from their food plants and stored, ready for use, in a special part of the gut.

The common Australian crow butterfly, which feeds on native figs and hoyas, was quick to adopt the notoriously toxic oleander as a food plant, when it was introduced from the Mediterranean. Perhaps its unusually obvious pupa, of a burnished silver or gold appearance, is designed to advertise its unpalatability. *Aristolochia* vines, eaten by birdwing, red-bellied swallowtail and big greasy caterpillars, are also toxic. Not all poisonous butterflies and moths acquire their toxins from food plants, however. Some are able to manufacture these themselves — certain moths can produce toxic substances such as cyanide.

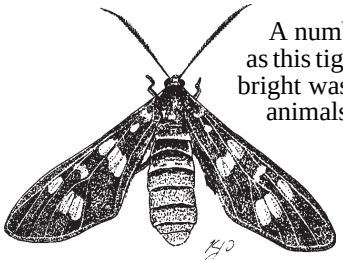
Bluff tactics

While many bright butterflies are toxic — and advertise it — some which are not take advantage of this by mimicking their companions' colours and patterns. During the course of evolution it is possible that the butterflies which most closely resembled the poisonous ones were those most likely to survive, this chance gene being transmitted to the next generation and so on. This strategy is only successful, however, if the poisonous butterfly is more common than its mimic — otherwise neither species benefits as predators realise that some are edible. In Australia, although this strategy is not especially common, the toxic lesser wanderer butterfly is mimicked by the female (but not the male) danaid eggfly and it is thought that the black and white aeroplane benefits from its similarity to the toxic Cairns hamadryad. In New Guinea a swallowtail butterfly mimics the poisonous zodiac (day-flying) moth.

Lesser wanderer

Danaid eggfly (female)

It is also possible to consider the dingy swallowtail, big greasy butterfly and red-bellied swallowtail as mimics since they look very similar. All feed on *Aristolochia* vine leaves so all three may be projecting a common 'don't eat me' message to which they all contribute. The similarity of all the toxic Australian crows no doubt produces the same joint benefits.



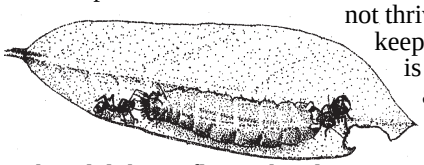
A number of brightly-coloured moths, such as this tiger moth, look rather like similarly bright wasps and no doubt escape attack from animals which do not wish to be stung.

Some night-flying moths have organs which function as ears and allow them to detect the ultrasound of insectivorous bats and thus avoid them. Some tiger moths are able to produce their own ultrasound which is the audible version of the bright colours of the day-flying insects and warns bats that they are not good to eat. Their clicks may even block the bats' sonar.

Enlisting mercenaries

Most butterflies in the blue group (Lycaenidae) have a special relationship with various species of ants. The ants feed on a sugary substance which the caterpillars produce from special glands in their skin, often when stimulated by the ants' antennae. This sugar hit may simply prevent the ants from eating the caterpillars. (Ant-attended caterpillars have particularly thick skins, which may also protect them from these potential predators.) However, it is presumed that the ants actively defend the caterpillars in return for this 'protection money'. The ant bodyguard is not entirely effective because many of the blues are attacked and killed by parasitic wasps and flies. Nonetheless, the relationship is a close one and, although some species fraternise with ants on a casual basis, some species do not thrive when separated from their keepers. Indeed, if the sugary fluid is not removed the caterpillars are in danger of becoming fatally mouldy.

Caterpillars of the common oak blue are attended by green tree ants

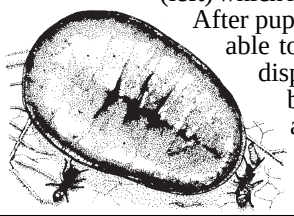


The adult butterflies, when laying eggs, seek out the presence of ants as well as the correct food plant. When they have hatched, the little caterpillars are often carried by the ants into their nest, or stowed in specially built shelters, where they are pampered — cleaned and cared for and possibly even fed. Even green tree ants, which normally do not hesitate to eat many caterpillars, turn off their aggressive instincts when caring for certain species of blues. As they grow, the caterpillars are carried out at night to their foodplant. (These butterflies have been observed to feed on an unusually large range of plants.)

When some caterpillars and even pupae were experimentally removed and placed a few metres from home, their ant guardians carried them back again.

The Apollo jewel butterfly has a close relationship with the ants which inhabit ant plants — bulbous epiphytes which can be seen growing on many coastal rainforest trees and which provide tunnels in which the ants nest. The Apollo jewel caterpillar also lives within the ant plant, emerging at night to feed on its leaves. Thus a complicated partnership exists between the ant plant, the ants and the butterfly — and the tree on which they all hang.

Some species are not very grateful. Caterpillars of the ant-blue butterflies eventually turn against their protectors and eat the ant larvae, while the moth butterfly caterpillar arrives, entirely uninvited, in an ants' nest where it also feeds on its unwilling hosts' babies (right). In this case the victims are the very aggressive green tree ants, but they are powerless against the exceptionally thick and flattened skin (left) which renders this caterpillar invulnerable. After pupating within its bunker, the adult is able to escape unscathed, abundant disposable scales on its wings and body dislodging as the angry ants attempt to cling to it.



*Illustrations marked * reproduced courtesy CSIRO, from* The Insects of Australia

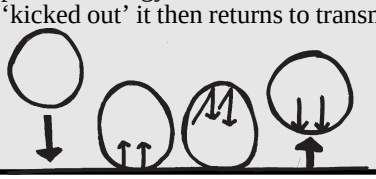
Questions & Answers

Q Why do some stones bounce?

A Basically the structure of the rock is the reason. Many rocks, such as sandstone or granite, do not bounce particularly dramatically because they are made up of a number of different materials which absorb shock waves. A sandstone, for example, may be composed of crystals of quartz embedded in a clay. If it is dropped, the energy of the shock wave is quickly dissipated as the quartz crystals and clay move very slightly in relation to each other.

Stones which bounce, however, are composed of a very homogenous material such as a microcrystalline quartz (a metamorphic rock which has been created under great pressure and heat) or very fine basalt. When one of these stones is dropped (on to a surface with similar qualities) the energy of the impact is not absorbed by the components of the stone, as would be the case with the sandstone, but transmitted evenly through the even-textured material. Then when it reaches the other side of the stone, if there is nothing else for it to be transmitted to, the wave of energy is reflected back to the side which experienced the original impact. This energy then causes the stone to bounce.

Metal and glass react in the same way. It is rather like one of those metal kinetic toys made up of a row of metal balls hung as parallel pendulums. When one is drawn back and allowed to fall on its neighbour very little of the energy is absorbed by the even texture of the neighbouring metal ball but is instead transmitted to the next ball and so on. The last ball in the line has nothing to pass the energy to so after it has 'kicked out' it then returns to transmit the energy back along the line. This energy is lost very slowly so the motion continues for a long time. However, if the balls were made of sandstone, the energy would be quickly absorbed by the movement of the grains within the rock — and as a toy it would be a definite disappointment.



Q Do orcas migrate north along the east coast of Australia with humpback whales?

A It appears that orcas, or killer whales as they are also known, do follow humpback whales to some extent, preying on newly born calves and older animals. Where they have come from, however, is unknown. They may have moved up from the Antarctic but this is somewhat doubtful given the distance involved, considering they are much smaller than the humpbacks. Individuals have been recorded moving from Alaska to central California, however, so a journey of this magnitude is not impossible. Otherwise they may simply move in from the Tasman Sea at humpback migration time. They are not seen every year but there is some evidence that the same pod, numbering a few dozen animals, is being sighted.

Little is known about orca movements. They are occasionally seen in the Great Barrier Reef region, usually well off shore, and a pod was sighted off Port Douglas on the outer Barrier Reef last November.

Distinguished by their conspicuous black and white markings, these are medium-sized whales growing up to 9m. They have a particularly large upper fin which, in adult males, has an erect appearance, reaching up to 1.8m high. In females and young males it is more curved and reaches up to 0.9m.

Tourist talk

ENGLISH	GERMAN	JAPANESE	
butterfly	Schmetterling	chou	蝶
moth	Motte	ga	蛾
caterpillar	Raupe	imomushi	いも虫
pupa	Puppe	sanagi	さなぎ
day-flying	tagaktiv	chuhiseino	昼飛性の
wings	Flügel	hane	翅
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mimic	imitieren	manesuru	真似する
scales	Schuppen	linpun	鱗粉

Facts and stats

About 330 — 86 percent — of Australia's 385 butterfly species occur in Queensland. Nearly 70 percent are in the Wet Tropics.

Contrary to popular belief, butterflies and moths are not incapable of flying if their scales are removed — they are just less colourful.

Caged insectivorous birds, although initially scared off by the eye-spots on butterflies, if given the opportunity to return and continue their investigation, lost their fear, called the bluff and ate the insects.

The Hercules moth of north Queensland (not to be confused with the smaller Atlas moth) is the largest in the world, reaching wingspans of over 30cm. Giant wood moths are the heaviest, weighing over 30g.

Some caterpillars can detect light through their skin.

The black and white tit butterfly is a pest of orchids; it lays on flower buds which are eaten by the caterpillars.

White nymph caterpillars feed gregariously on stinging trees.

Some plants catch butterflies. They can become snared on the sticky leaves of the insectivorous sundew while the flowers of the rubber vine are known to trap the legs or proboscis of butterflies searching for nectar. Unable to escape, the unfortunate creatures eventually die.

Some moth caterpillars such as armyworms and the caterpillars of a hawk moth if living singly are pale in colour, but are dark if living in dense populations. The colour is controlled by their hormones.

Ulysses butterflies are attracted to red, sometimes landing on red cars as well as on red flowers. Blue triangle butterflies are attracted to blue and will readily land on blue clothing

Certain moths can detect a 15-watt ultraviolet lamp from a distance of 250m. Activity in nocturnal moths may be triggered by darkness, light reducing activity.

Bogong moths are famous for their migrations in southern Australia, where they spend the summer in huge numbers in caves. They return to their breeding grounds when rains have encouraged growth of larval food plants — unavailable during the dry summer.

Individual monarchs have been recorded covering up to 4000km in north America. The entire round-trip migration, however, involves several generations.

Out and about

AVAILABLE

A comprehensive list of **food plants for butterfly and moth caterpillars** in north-east Queensland is available. The host plants are listed, in alphabetical order, alongside the butterfly and moth species which feed on them. Codes indicate whether they are trees, shrubs, vines or herbaceous plants. If you would like a copy, send an e-mail or stamped, addressed A4-sized envelope to the editor, address on the back page.

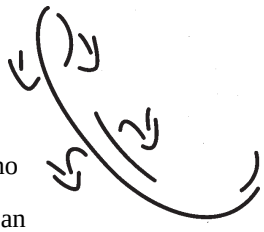
Banana bush (*Tabernaemontana pandacaqui*) is a shrub or small shrubby tree named for the bright yellow fruit it produces at about this time of year. Carried in pairs, these split open when ripe to reveal bright red flesh in which the seeds are embedded.

The **peppermint stick insect** is a wonderful creature — but its beauty could be its undoing, unless care is taken. Ranging in colour from bright green to turquoise, the insect lives on coastal pandanus plants, often nestling inconspicuously in the groove along the mid rib of the prickly leaves. Its range is very limited, with the only known populations in the vicinity of Cape Tribulation, Daintree River, Etty Bay and Mission Beach.

When disturbed, the insect sprays a substance which smells of peppermint. Apart from habitat destruction, it is this feature which could lead to its decline. Tour operators, particularly at Cape Tribulation, have been observed pulling back leaves and poking the insects to provoke a minty reaction. Although this is good entertainment, if the creatures are provoked repeatedly they may suffer from stress. In addition, interference with the pandanus plants can lead to a deterioration of its food source.

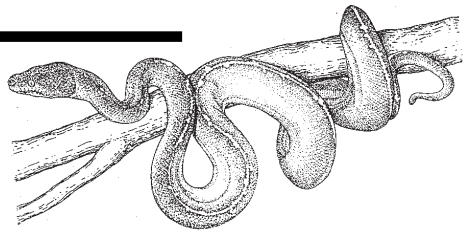
Golden pendas (*Xanthostemon chrysanthus*) flowered magnificently around Cairns and to the north from mid-March 1999. This began roughly five weeks after Cyclone Rona (11-12 February 1999) so it is interesting to note that exactly the same time period elapsed between Cyclone Justin (22 March 1997) and the last local magnificent flowering in late April that year.

The two events may be coincidental. However, it is likely that the flowering is a response to stress, the plant perhaps making an effort to reproduce in case it dies — which is quite a common plant response to stress. Since the pendas have not responded in the same way to similar flooding on other occasions, the stress may not be due to the sudden deluge. Wind may well be the stress factor involved — leaves being violently vibrated can sustain quite a large amount of internal damage. However, cyclones are known to carry large amounts of salt quite some distance from the coast so this could be the key factor. On the other hand the trees may have benefited from an increase in nutrients suddenly available to their shallow rootlets as large amounts of leaf debris on the ground rots. Whatever the reason, this is something to look out for after the next cyclone!



Rob Whiston, who lives south of Cooktown, made an interesting observation one evening in mid March. A **ring-tailed gecko**, about 24cm in length, leapt off a wall and seized a 10cm long adult northern dtella gecko from the floor. Holding the dtella by the side of the head and neck it quickly returned to the wall, positioning itself so that the dtella was unable to grip the wall surface. During the next 35 minutes the struggling dtella became weaker until all signs of life ceased. The ring-tailed gecko then carried its victim up the wall and, by pushing it against the ceiling, managed to consume it within five minutes.

Although he had not observed this during the 20 years of living in the area, Rob described the ring-tailed gecko's attack as apparently 'well-practised'! The dtellas, which are sometimes abundant, are often preyed on by brown tree snakes and white-lipped frogs around his house.



Smugglers of wildlife may be doing even more harm than they realise. In May 1998 two Singaporean nationals were arrested in Cairns for attempting to smuggle 10 juvenile **green pythons** into Australia (in their trousers!). The rescued snakes, however, are now all dead. When seized, they were placed in quarantine but two of the pythons died soon afterwards. They were sent to Victoria for testing, at which point an iridovirus, which is unknown in Australian reptiles or amphibians, was found. A third snake died and the rest had to be euthanased, rather than risk the virus spreading to Australian animals. Had the smugglers not been caught, who knows what would have happened to our native wildlife. Diseases can spread quickly but are difficult to spot until the animals become seriously ill.

QUEENSLAND GOVERNMENT *Environmental Protection Agency*

The **Environmental Protection Agency (EPA)**, which was launched by Premier Peter Beattie in Brisbane on 4 March 1999, replacing the Department of Environment and Heritage.

Bookshelf

Butterflies of Australia
I.F.B. Common and D.F.Waterhouse
Angus and Robertson Publishers (1981)

This is the Australian butterfly bible - —although rather detailed for amateur identification. It has a good introduction.

Moths of Australia
I.F.B.Common
Melbourne University Press (1990)

The moth equivalent of the above book — and one of the very few books on Australian moths. Colour plates show how attractive many of the species are.

Australian Tropical Butterflies
Peter Valentine, Clifford and Dawn Frith
Tropical Australia Graphics (1988)

This is the perfect book for anyone interested in our local butterflies. Of manageable size and price, it has excellent photographs and details of 118 species.

A Field Guide to Australian Butterflies
Robert Fisher
Surrey Beatty and Sons Pty Limited (1995)

Identification guide with photographs.

How to Attract Butterflies to your Garden
Densey Clyne
Reed Books (1990)

Covers a few representative species in each family with good photographs of different stages and details of food plants.
One of insect enthusiast Densey Clyne's delightful books, many of which are aimed at children but are well worth a look.

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NB. Local foodplant lists are available **— see page 7**

Posters
Australian Butterflies
Domino Books Ltd. (1980)

An excellent inexpensive quick identification guide with 250 colour illustrations. (It does not include skippers.)

This newsletter was produced by The Environmental Protection Agency with funding from the Wet Tropics Management Authority.

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WET TROPICS MANAGEMENT AUTHORITY

Queensland Government
Environmental Protection Agency
Queensland Parks and Wildlife Service