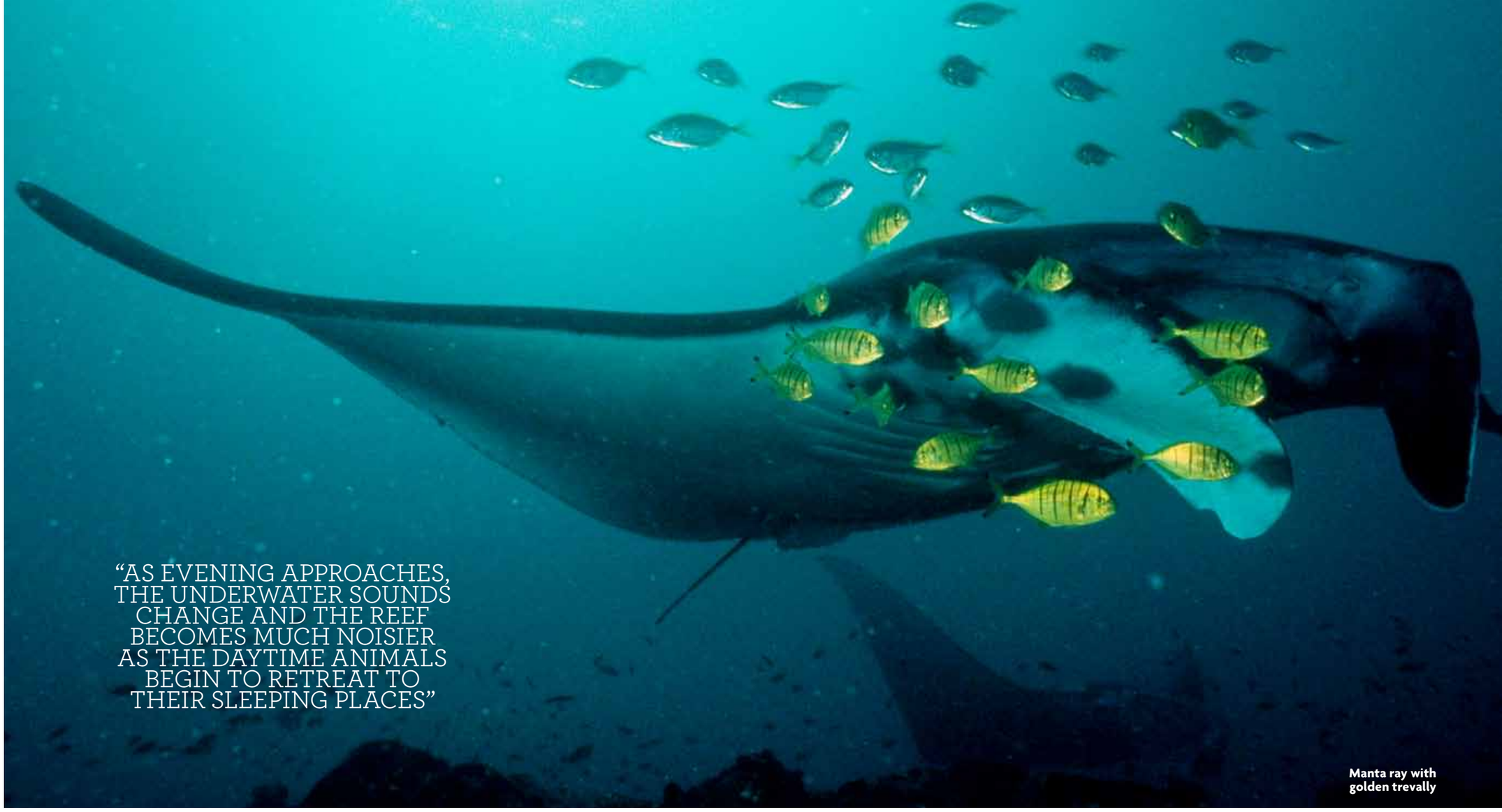
WORDS **LEN ZELL**

UNDERWATER QLD

coral music

In a new book, one of the world's foremost Great Barrier Reef experts details a day in the life of this vast marine ecosystem.

Orange fairy basslets feeding on plankton with feather stars in the foreground; lionfish (opposite)



"AS EVENING APPROACHES, THE UNDERWATER SOUNDS CHANGE AND THE REEF BECOMES MUCH NOISIER AS THE DAYTIME ANIMALS BEGIN TO RETREAT TO THEIR SLEEPING PLACES"

Manta ray with golden trevally

INTERNATIONALLY RECOGNISED as the greatest reef system on Earth, the Great Barrier Reef conjures up images of azure waters teeming with colourful fish against a background of corals and algae of every shape, form and colour. This amazing system, which runs along the north-eastern coast of the Australian continent, represents about 10 per cent of the coral reefs in the world.

The Great Barrier Reef extends from Bramble Cay in the north to Lady Elliot Island in the south – more than 2300km – but attractive coral reef systems continue down the east coast of Australia to Lord Howe Island, the southernmost coral reef in the Pacific. In the north, the reef systems extend east and west into the Coral and Arafura seas, respectively, joining up with the Coral Triangle around Papua New Guinea.

In the Reef are more than 3000 individual reefs and almost 1300 islands, including the 400 islands in the Torres Strait, making it one of the single largest ecosystems on the planet. Each reef is constructed of pure limestone produced by animals and algae – except those reefs near land, which may include some sediment.

The Great Barrier Reef at noon

◇◇◇

It is noon on a hot and humid summer's day, and a thriving reef ecosystem lies beneath the clear, calm waters. At this time of day the reef-building corals are all in the "farming" phase. The coral animals, or polyps, must maximise their surface area so the colourful algae, called zooxanthellae, which live in the coral, can absorb light and process it with the carbon dioxide, phosphate and nitrate wastes from the coral colony. In exchange, the corals receive oxygen, sugars and protein, the by-products of the algae's photosynthesis.

As a result of this symbiotic process, the polyps produce waste – limestone in a porous crystalline form – laid down in the most intricate of patterns, a different one for each species. These form the coral skeleton, or reef.

Corals are vulnerable to species that can reach them in their limey cups. The beaked butterfly fish, for example, feeds on both the coral polyps and the small animals living among them. It does this with its very small mouth, which is on the end of its long nose. Meanwhile the parrotfish and the bumphead parrotfish swim in and bite off whole hunks of coral to get at the algae – it's possible to hear them crunching their way across the reef top, especially on the rising tide, when they swim up from deeper waters. They excrete sand, so play an important part in the growth and erosion of the reef system.

The other marine creatures seem relaxed, as if they are affected by the hot, humid conditions. Fish cruise around while soft corals wave their frond or whip shapes in the passing current, catching any food particles. The buried sea cucumber pokes its feathery arms above the sandy sea floor, looking for food; and crinoids, or feather stars, also send out their arms in search of prey.

The soft corals and other filter feeders use a variety of capture and kill techniques to satisfy their hunger. The prawn-killing mantis shrimp lurks at the mouth of its burrow, then demonstrates the fastest move in the animal kingdom as it spears its prey. A goatfish moves across the sand, wriggling the two chemo-sensory barbels or "whiskers" on its chin into the sand to quickly burrow out any prey it detects. Wrasse will follow, capturing any other creatures the goatfish may disturb.

Out in the deeper water, on the flat sandy floors adjacent to the reefs, it is common to see hundreds of garden eels – long worm-like fish – with about 60cm of their bodies out of their burrows ›

Prawn-killing mantis shrimp

swaying with the current, waiting for passing food. One quick move and they will all disappear, only to re-emerge as soon as the threat has passed on.

The aptly named Christmas tree worm, which is renowned for its amazing range of bright colours, lives in a tube in a coral head. Whenever it is disturbed, this delicate creature will draw back its pair of feathery, spiral-shaped cones into the tube, slamming a cap tightly over them. These worms are known to form dense colonies, especially on kidney coral heads.

The giant clam is spectacular. Its mantle, which is 50cm wide when the shell is fully relaxed and "farming", can be all the colours of the rainbow. Like the corals, giant clams have zooxanthellae in their tissues so they are farmers by day and filter feeders on small animals by night. There are many species of bivalves on the Great Barrier Reef. Some use both chemical and physical erosion to burrow into the coral, while others live freely on the sea floor, swimming about by squirting water from between their shells.

At dusk

◇◇◇

As evening approaches, the underwater sounds change and the reef becomes much noisier as the daytime animals begin to retreat to their sleeping places. A little later, the night-time species will emerge, some to forage all night, others to feed at dusk and dawn only. This "change of shifts" is a favourite attraction for many divers. The small coris will seem to ❯

Christmas tree worms; emperor shrimp on a sea cucumber (right)

Orange clownfish befriends anemone

dive-bomb a patch of sand and disappear as it spends the night, like many other daytime species, buried.

With some parrotfish species, a pair will spiral towards the surface to release their eggs and sperm together in a cloud of gametes (reproductive cells) before dashing back to the protection of the reef. The water becomes a little murky as more and more gametes are released.

At this time of day, the cruising high-speed fish such as trevally will burst out of the gloom into schooling balls of bait fish near coral heads, while lionfish will drift among the baitfish and snap one up every now and then.

Octopi will become active, moving from one hide to the next. Occasionally they will turn pure white and cover a small coral head to confuse the fish or crab within, which thinks it can still see daylight and tries to escape the probing tentacle, only to become the octopus' next meal.

Night feeders

◇◇◇

At night the corals become carnivores by pumping out their tentacles and using them to capture the zooplankton that rise up from the sea floor. As a tentacle makes contact with one of these small animals, the coral uses stinging capsules to capture and paralyse its prey, then folds it into its mouth, where it is digested. The coral ejects any large pieces of waste from its mouth, but it keeps the chemical wastes to feed the zooxanthellae during the farming phase in daylight hours.

During the night, rays hunt the sands. When a micro-electric current from the breath or twitch of a buried animal is detected, it spurts a jet of water onto the spot and captures the hidden mollusc, crab or fish. Sea snakes and sharks also hunt at night; both look among the corals for sleeping fish.

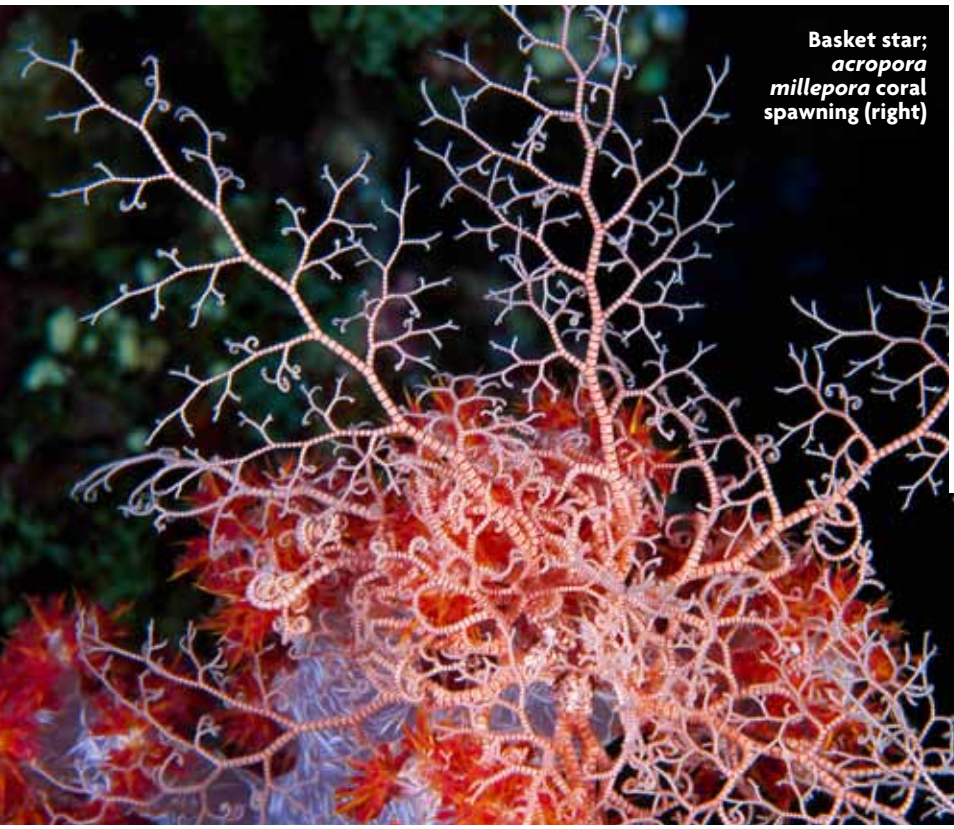
Several species of shrimp, which prefer to hide in dark crevices during the day, usually clean fish at night, performing a fascinating series of dances on any fish that "parks" in the right spot. The clown shrimp is a fierce predator, which uses its claws to pierce the skin of a crown-of-thorns sea star before eating its flesh.

The basket star may live in the same place all its life, but it can move around. It unfolds its delicate fronds from a crevice in the coral then casts its net of many-branched arms, which can span two metres, across the current to feed. It collapses one arm at a time into its mouth and scrapes off any food.

Spawning at night

◇◇◇

Once a year, usually about the fifth night after the first or second full moon in summer, most species of coral have amassed their eggs and sperm into bundles in their gut cavity, waiting for night. As the sea darkens, many of the ❯



Basket star; *acropora millepora* coral spawning (right)

ONLINE

WHAT LIES BENEATH...

For 20 top Australian shipwreck dive sites, plunge into **qantas.com/travelinsider**

corals begin to bulge at the mouth with pink, yellow, white or orange as they prepare their egg and sperm bundles for ejection. Once all the conditions – such as lunar cycle, day length, tide height, temperature and salinity – are right, the corals begin to release their gametes.

Most are hermaphrodites, which release their eggs and sperm separately, while some are monosexual – the males release their smoke-like sperm while the females release bundles or even single eggs into the sea in clouds of red, yellow, orange and almost white. All rise slowly to the surface, where the process of fertilisation begins. This mass spawning process has been called an "upside down snowstorm".

Banded brittle stars, 50cm across, are also spawning. The males are inside a branching coral colony, emitting their sperm so that it looks as if the coral itself is smoking. Standing up on two of her five arms, the female rapidly whips the other three backwards and forwards as she releases a steady stream of individual red eggs into the water.

Sea cucumbers, not wanting to miss the party, stand up on about a third of their body length. With two-thirds of their bodies vertical and their "heads" bent horizontal, they too begin to sway gently back and forth as the females release their red eggs and the males release a steady stream of grey sperm from the genital pores on their heads. The sperm and eggs float to the surface.

✚ Extracted from *The Great Barrier Reef: A Journey Through The World's Greatest Natural Wonder* by Len Zell (Murdoch Books, $60)

Female crown-of-thorn sea stars will release up to 250 million eggs in one year, and many other species cast adrift large numbers of eggs and sperm. It is unknown what their survival rate is, as so many factors affect their success. Probably the most important is to be able to dodge the walls and carpets of mouths that confront them on any reef surface and find a spot just right for settlement – a very difficult task.

Clams breed by releasing their eggs and sperm in several convulsive closures, squirting the gametes up into the water column to speed their rise to the surface.

Some of the stinging hydroids and soft corals release small medusae, which are like little sea jellies, of both sexes. These medusae release the eggs and sperm, which go through the same cycle as the hard corals.

This mass spawning can last for three or four hours, and by dawn, visibility in the water may drop from 30m to only 10m. The sea is covered with a pink-yellow slick known as coral spawn. Divers call the water "gamete soup" due to the loss of visibility and a fishy smell that clings to them as they leave the water.

As dawn breaks on a new day, the seabirds and pigeons are already heading for their foraging grounds while the fish and other species that had been sleeping in crevices, cocoons or sandy hideouts begin to emerge. The reef seems "spent" – the fish have obviously gorged too much and the corals will need some time to recover, but for other species that neither spawn nor feed on spawn, it is life as usual.