MARINE ECOLOGY

Blue ring of confidence

Marine ecologist **Jamie Watts** delves into what's known about the photogenic but much-feared blue-ring octopus clan

story by Jamie Watts and Malcolm Nobbs

It's pretty close in size and shape to a folded cocktail umbrella, barely visible in the gloom, and it's one of the most remarkable things I've ever seen underwater. How did I manage to spot it? At 30 metres down on a rubble slope, it might just have been another bit of sandy detritus, until I waved my hand over the top of it. Octopus skin has no blue pigment, yet those vivid, electric blue rings instantly flash like internal LED lights, outlined a little more slowly by the dark patterning that is a familiar sight to anyone fortunate enough to have encountered other octopus underwater.

Light fantastic

This mesmerising light show is a warning. Despite being smaller than my little finger, this beastie is telling me to stay away. And for good reasons of self-preservation, as well as basic courtesy, I'm going to do as it suggests.

Cephalopods – octopuses, squids, cuttlefish and their cousins – are all intriguing. It's down to their alien visual language, the incredible high-speed nervous system that turns their whole skin into a sophisticated communication system, their otherworldly senses, and how they manage to be so smart and become such impressive killers in such brief lives. But among the cephalopods, the miniscule blue-ringed octopus stands apart, punching far, far above its weight, both as a predator and as a sophisticated visual communicator.

Twenty-six is the first number you hear linked to these octopuses: one blue-ring has enough venom to kill 26 adult humans. The second is 1,200: the venom produced by bacteria in the salivary glands of blue-rings (and by pufferfish) is 1,200 times more toxic than cyanide.

Yes, blue-rings are, to an insane, ridiculous extent, both venomous (to anything they bite or dribble near) and poisonous (to anything that tries to eat them). Sadly, almost all the research that has been carried out on them has focused on the poison; it's surprisingly hard to find out anything more revealing about the lives of these splendid little creatures. We're not even sure how many species there are or the full geographical range of each. We can only surmise a rough overview of where and how they live their lives.

Different enough to be given their own genus, *Hapalochlaena*, blue-rings are

↑Above: a blue-lined octopus swims up off the reef at Nelson Bay

↓Below: A blue-lined octopus flashes vividly at the photographer

PHOTOS: MALCOLM NOBBS

PHOTO: MALCOLM NOBBS

←Left: a Greater blue-ring from Indonesia

↓Below: Typical pose of a blue-lined octopus ambling over the reef at Nelson Bay

PHOTO: MALCOLM NOBBS

found inshore from India to Japan and the south of Australia. They like shallow water, and can often be found in rock pools, sand, reefs, seagrass and rubble down to 30m or more. Most species seem to be almost exclusive to Australia, it being traditional for Aussies to live alongside the world's deadly animals.

Short lives

One reason we don't know much about blue-rings is that they are tiny and cryptic. They spend most of their time blending in with their background; and most species seem to be more active at night. Night-diving in the Philippines, photographer Malcolm Nobbs won a bet with his guide on who spot the first one. "The flashing blue warning signals were impossible for me to miss. The tiny octopus didn't back off, its tentacles unfurled into a dramatically aggressive posture, ready to strike like a cobra. I knew it was a bluff – they are not aggressive creatures – but it was certainly an impressive bluff."

They're all small, thimble-shaped octopuses, short-armed and mostly with a pointed tip to their mantle. Depending on the species, they are adult at about six to 20 grams and measure eight to 20 centimetres to the tips of their outstretched arms.

Most blue-rings only seem to have ink glands for the first two or three weeks, when they are rice-grain-sized babies. Although, adult blue-lined octopuses have been seen by divers in Nelson Bay, Australia, using ink and some greater blue-rings have been recorded releasing their deadly toxin with the ink. From aquarium studies it seems, blue-rings lose their ink as they grow, building up venom in their salivary glands and starting to hunt minuscule crustaceans at about a month old.

They develop the ability to flash their warning rings a couple of weeks later, when pea-sized. They continue to grow and mature at a spectacular rate, becoming adult four months after hatching. The rest of their life seems to be spent hunting (mostly crabs and other crustaceans), growing and trying to mate. Most blue-rings live a few months, others in some places apparently make it into their second year.

Females only produce 50-100 eggs and males about the same number of spermatophores. As they die soon after they've finished breeding, it makes sense to focus on where you share these precious and limited resources. So mating strategy becomes serious, and blue-rings seem to try to mate with as many different partners as possible during their two-month reproductive adult life. Mating itself consists of a brief introductory caress, followed by a pounce and a smother by the male, covering his mate for an hour, but occasionally up to six hours, before she pushes him off. The bigger and older a blue-ring is, the more sex it seems to have. Some males seek out smaller and younger females to try to ensure their sperm packet is at the front of the queue, as it were. Mating is observed from time to time by divers, and often exceeds the length of a dive.

Fertilised eggs are either laid in batches or incubated underneath the female's arm skirt for a couple of months, depending on the species. As in all octopuses, just before she releases the fertilised eggs, the mother stops eating and slowly dies over the next weeks while caring for her unborn next generation.

Hunter and hunted

Small, fleshy and slow-moving, blue-rings would be easy morsels for predators were it not for their remarkable camouflage ability, common to all octopuses, and the stunning warning coloration they can flash in a split second. The electric blue of their rings comes from iridescent mirror-like plates called iridophores in their skin, whose orientation is controlled by tiny muscles and remarkably coordinated to reflect blue light. The skin above the iridophores, unusually, doesn't have the brownish pigment cells found all over the skin of other octopuses, squids and cuttlefish, so there is nothing to cover the magnificent glow.

The legendary venom of blue-rings is mostly tetrodotoxin, which paralyses prey almost instantly, so these soft animals do not have to struggle with shelled, clawed or toothed prey. They usually bite and inject saliva but can sometimes simply salivate venom into the water near their prey to paralyse from a short distance. The venomous saliva seems to spread about the animal and people eating blue-rings have, not surprisingly, died.

The venom of these smart and canny hunters is an effective attack and defence against almost anything, although some animals are apparently not affected. I've heard reports from different sources (and there's a YouTube video you can watch) of mantis shrimps – probably the smartest of all invertebrates – pummeling blue-rings at arm's length then tucking in. Cuttlefishes and filefishes have also been observed preying on blue-rings. Why they are not affected by the toxin is a mystery. They don't always rely on their venom however. Nic Rewitt has reported blue-lined octopuses in Nelson Bay mimicking crabs and cuttlefishes to startle and confuse would-be attackers.

After the bite

Tetrodotoxin, a paralysing agent, forms the major part of the venom. Smaller secondary salivary glands produce a cocktail of other toxins, some paralytic to crustaceans, some which seem to soften meat and partly digest prey. Fortunately for humans unlucky enough to get bitten (and you have to behave rather stupidly, handling or seriously harassing an octopus to earn yourself a bite), these other poisons seem to be released in such tiny amounts as to not affect a human. All you have to deal with is tetrodotoxin, one of the most deadly biological substances known.

So what happens if you get bitten? You probably wouldn't even feel the tiny bite from the tiny beak. The effects of the poison start to appear after a few minutes to a few hours. Your extremities will tingle and go numb, then you'll feel nauseous and achy and start going into spasm and shutting down as every muscle in your body is paralysed. You'll remain conscious the whole time, and there'll be no damage to your tissues. Fortunately, your body steadily breaks the toxin down and excretes it after 12 hours or so.

Untreated, you'd die quickly of suffocation, as the muscles of your respiratory and circulatory systems stop working. There's no anti-venom, but treatment is really rather simple – you just need artificial respiration for 12 to 18 hours, until your body breaks down ➔

PHOTO: BRYAN MAYES

↑Above: Eggs are incubated underneath the female's arm skirt for a couple of months

↓Below: Mating blue-lined octopus in Nelson Bay

PHOTO © NIC REWITT

PHOTO: JAMIE WATTS

Above: A blue-ring from Lembeh – probably one of several undescribed variants

the poison and you get your breathing and circulation back. If you make it through 24 hours, you'll probably make a full recovery, with one hell of a story to tell and no long-term effects beyond a healthy respect for small molluscs. Just for the record, this is not a suggestion that you should try.

Respiratory arrest and death are often reported to occur within minutes, although onset of the shutdown seems to vary and can take several hours. Of 12 fully documented bites, six showed no signs of respiratory paralysis, so perhaps the tetrodotoxin is not always released in a bite, or perhaps it's not always there. Personally, I'm not going to take those odds, I'm going to continue to seek out these exotic mini-beasts and watch them with glee from a respectful distance.

Below: A greater blue-ringed octopus from Indonesia

PHOTO: MALCOLM NOBBS

What's in a name?

Greater blue-ringed octopus

The tiny blue-rings found from Sri Lanka through much of the Indonesian archipelago, up to Japan and out to the west Pacific islands are treated as a single species, the greater blue-ringed octopus, *Hapalochlaena lunulata*. However, it is possible that there are a few cryptic species among them that haven't yet been described. These smaller blue-rings have a mantle length of around five centimetres and weigh around 10 grams. The 'greater' refers to the relatively large rings, not the size of the animal. Greater blue-rings have characteristic blue lines through their eyes. They seem to develop their young quickly, hatching their eggs for a brief dispersal phase in the plankton, their whole life cycle over in less than a year. However, the individual I photographed in the Lembeh Strait had rather small rings and no eye-line. It may be another species, or it may be simply a young greater blue-ring.

Southern or lesser blue-ringed octopus

Hapalochlaena maculos is a larger octopus, growing to the size of a child's hand, with smaller blue rings (hence the 'lesser'). It is usually found in cooler inshore waters off southern Australia. Unlike its smaller, greater-ringed cousin, it seems to invest a little longer in its young, who hatch as tiny versions of their parents. Like greater blue-rings, they live less than a year.

Northern Australian greater blue-ringed octopus

This blue-ring is, confusingly, a little larger again, and doesn't yet have a scientific name. This seems to be a larger version of the greater blue-ring, only found off northern Australia.

Blue-lined octopus

Hapalochlaena fasciata may be one species or two. Medium-sized, and apparently preferring moderately warm, subtropical water, blue-lines are found in eastern Australia and the Korean archipelago. Blue-lines have a combination of streaks on the mantle and rings on the arms. Malcolm frequently sees blue-lined octopus in the shallow waters of Nelson Bay, north of Sydney. His sightings are generally on night dives but in the Australian late summer, the octopus can be seen in the day, presumably because the octopuses are making themselves visible for mating. In February this year, he counted up to four Blue-lined octopus on most daytime dives.

Bengal blue-ringed octopus

Hapalochlaena nierstrasI, a rather elegant little octopus with a more rounded-mantled and long-arms, is only known from a couple of specimens from India.