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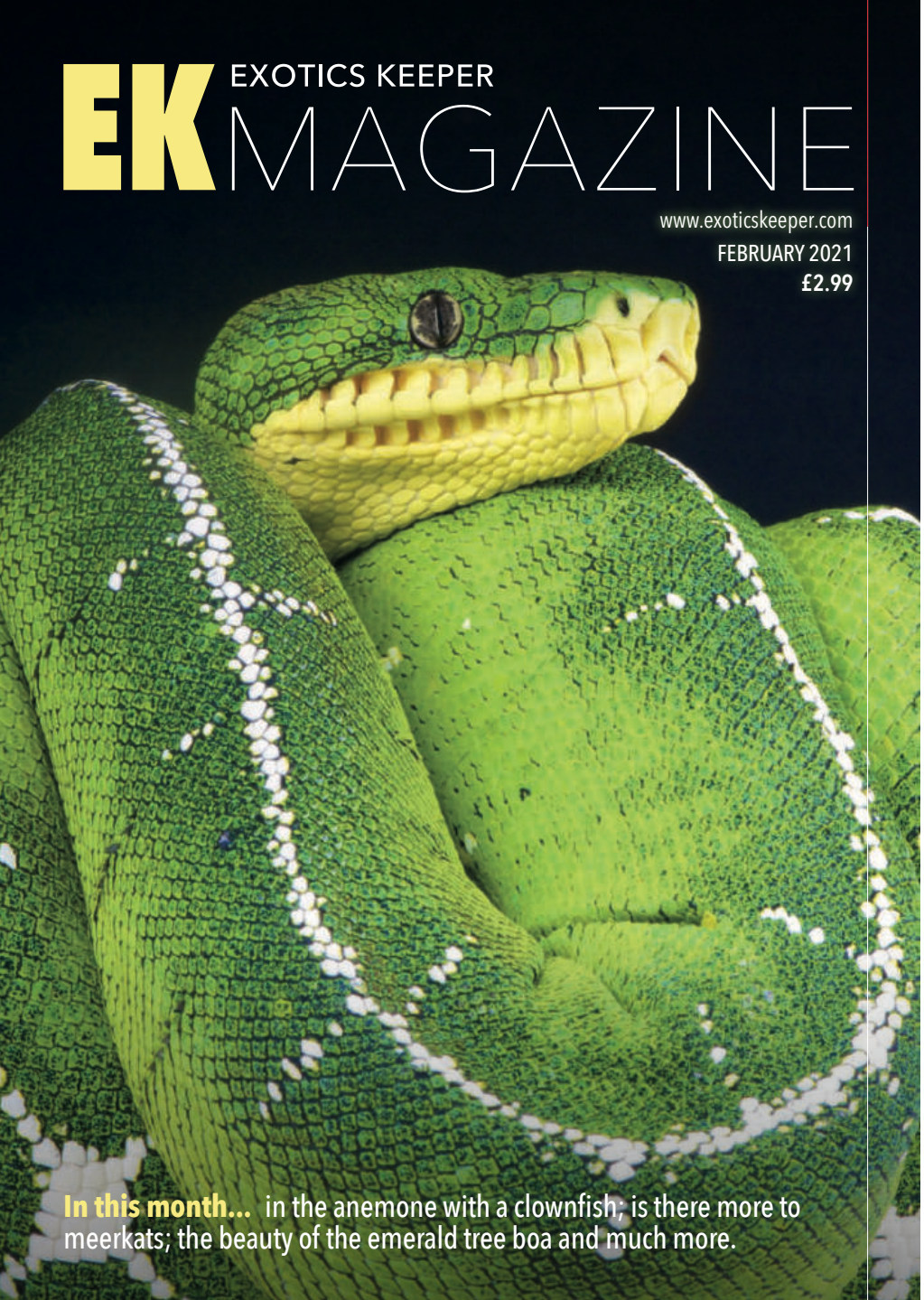

In this month... in the anemone with a clownfish; is there more to meerkats; the beauty of the emerald tree boa and much more.

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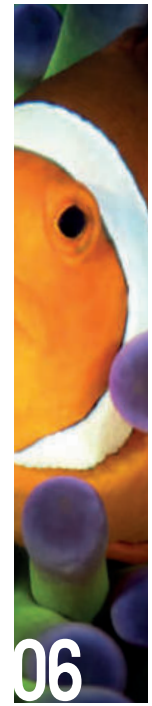
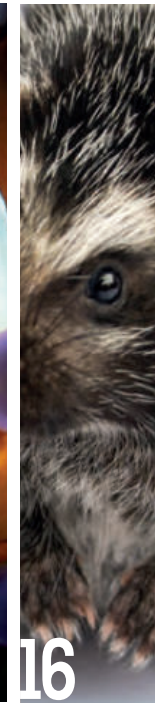
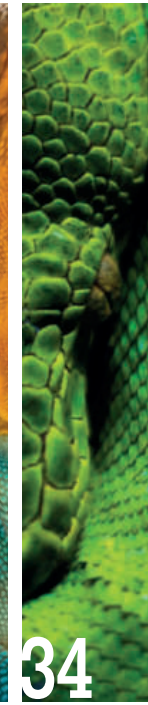






FINDING THE REAL **NEMO**

Clownfish are one of the most recognisable marine fish on the planet. However, there's plenty to learn about these fascinating fish. Evolutionary biologist working on clownfish Dr Suzanne Mills from EHE - PSL University Paris, at CRIOBE, gives us ten things you probably didn't know about Nemo.

Ocellaris clownfish *(Amphiprion ocellaris)* |

The world fell in love with clownfish following the release of Disney's feel-good animation movie Finding Nemo. With millions of people keeping marine fish around the world, we catch up with marine biologist Dr Suzanne Mills to find out what Nemo is really like.

Clownfish are highly territorial

One of the main reasons Dr Mills decided to work with clownfish is because they're relatively easy to find. "Before working with clownfish I studied a few different animals, such as bank voles (*Myodes glareolus)* in Finland and side blotched lizards (*Uta stansburiana*) in California. Both these animals had a defined home range which made finding and studying the same individuals relatively easy – you pretty much know where to find them. Studying fish in the South Pacific was going to be much harder because most fish species move over greater distances. Thankfully, clownfish make their home hiding within a particular anemone and remain there their whole life. So when you need to find a particular fish, you know exactly where to look."

THE EXPERT

Following a PhD at University of East Anglia in Norwich, England Dr Suzanne Mills has spent over 20 years researching biology in numerous parts of the world. After her post-doc in Finland and California, and spending time working in the scattered islands around Madagascar Dr Mills has spent the last 10 years in the French Polynesian island of Moorea where she now is based.

Some clownfish don't look like Nemo

There are around 30 different species of clownfish, or anemonefishes, many of which look rather different to the ones we usually see in the media.

For the record, Nemo was a common clownfish (*Amphiprion ocellaris*) which is the most well-known of all the species.

Male clownfish turn into females if they lose their mate

In the film, Nemo's mother is eaten by a barracuda, leaving Nemo's father to care for him. In real life with the female gone, it is likely that Nemo's father would have changed sexes to become a fierce, protective female, at the same time the largest immature subadult would become a mature male and later they would mate with each other and Nemo's ex-father would lay eggs. The sex-change process takes a few weeks and makes lots of sense if you know how clownfish live. Female clownfish are larger and more aggressive and protective over their anemone than the males.

Some clownfish are natural stress-heads

Measuring the stress hormone cortisol, Dr Mills found that, when subjected to stressful stimuli, some clownfish remained relatively calm, whereas others were significantly more stressed. "This was a consistent response by the same individuals. Whichever stress stimulus we used, the same individuals became stressed every time, while others remained calm every time."

The stresses Dr Mills used were those which would be routinely inflicted by humans, such as boat noise or artificial night time lighting, as well as anemone bleaching caused by climate change, with the experiments being conducted in wild environments – specifically the lagoon in French Polynesia where Dr Mills works. "So the question is, will this high stress response help the clownfish cope with environmental change?" said Dr Mills. "Trials conducted in the wild are more authentic and accurate than those done in aquaria as you are including so many wild variables such as predation, competition and the availability of hides and refuges."

Dr Mills also makes the point that stress is not entirely a bad thing as all animals need to react accordingly in response to stress. Having a big stress response can often be a benefit as the ability to cope with stress and respond in a suitable manner can increase the animal's chances of survival and the likelihood that an animal can successfully mate.

Wild clownfish babies disappear for two weeks

After breeding, clownfish parents lay their eggs under the relative safety of their anemone's tentacles and protect them from predation, remove algae and fan them to provide oxygen for six or seven days before they hatch. The young, just a couple of millimetres long at this point, then disappear out into the ocean for two weeks, with many returning to settle near to where they were born, but not in the same anemone.

Research by Dr Mills' husband Dr Ricardo Beldade into clownfish communities in Moorea, French Polynesia, found that only about one-third of the fish which make a home on any specific reef came from parents who lived there too. The remaining two-thirds of the fish that live on the reef were born much further afield.

Research found that clownfish mothers with a low stress response produce relatively small babies whereas those with a high stress response produce relatively large young. Initially it was thought the larger babies were stronger and able to swim further distances to find new habitats, while smaller offspring stayed local. However, it appears to be the larger young that stay local because they are stronger and more able to resist the currents which might carry them further afield. Instead of being swept away, the stronger babies can return home to the same island and set up home there.

SHRIMP FRIENDS

While clownfish have been observed attacking much larger animals that come near, Dr Mills has never seen them attack the various species of shrimp which live alongside the clownfish and share the same habitats.

Captive-bred clownfish eggs are tougher than wild clownfish eggs

Captive clownfish eggs hatched in laboratory aquariums will usually have a near 100% hatch rate, but wild eggs harvested to be hatched in labs have a far lower success. This is likely because captive populations have been selectively bred to be suitable for aquarium life, with those that do well being chosen as breeding stock.

However, human experience plays a huge role too.

"As scientists we had to admit that we were pretty useless at hatching clownfish eggs in captivity," said Dr Mills, "so we eventually recruited an aquarist lab technician, Till Deuss who had the right experience. He was amazing! Within two months he'd improved our hatch rate enormously, but even he said the clownfish species we work with is one of the most difficult he's ever had to rear. It just goes to show that aquarium specialists and their knowledge are invaluable to science."

Clownfish and anemones protect one another

Clownfish and anemones each benefit from the symbiotic relationship. Clownfish will attack much larger animals which get too close and have been observed biting at the eyes of turtles, attacking sharks and even lunging at the masks of human divers. In return for patrolling their patch the clownfish can happily live among the stinging tentacles of the anemone, shielded by a mucus membrane which protects them from the anemone's poison.

Sustainable utilisation is important

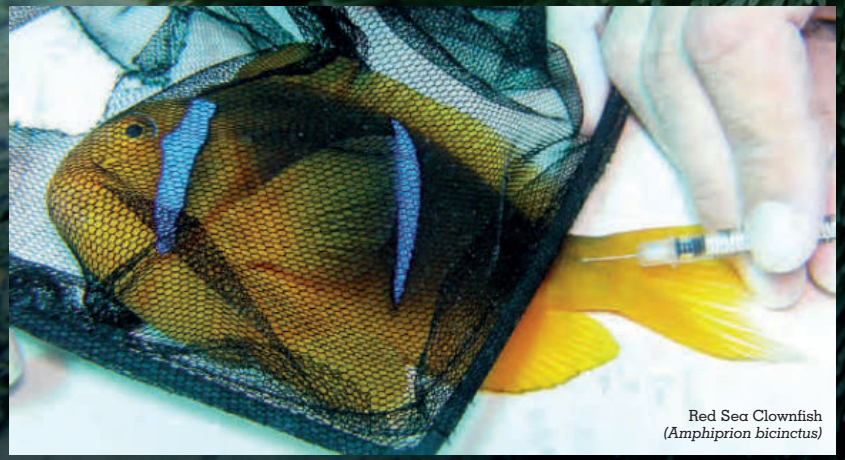
While clownfish populations are stable and seem to be doing OK in the area where Dr Mills works, collection of adult clownfish for the pet trade does occur.

Dr Mills relates a story about the clownfish she studies in the lagoon off Moorea in French Polynesia. "Sometimes a whole section of reef will lose its resident clownfish overnight. We go to look for the fish we've been studying for years, and they're suddenly gone – we think most likely collected for the pet trade. Without the clownfish's protection the anemones are soon predated upon by turtles. We're pretty sure our research fish are being collected, because it's invariably the ones in easy-to-reach locations near channels or the coast which go missing. Those which are a half-hour boat ride away and hard to get to through coral heads are still there. We've often heard from dive-tourism operators that the clownfish they went to see had disappeared too."

That said, while coral cover in the lagoon has fluctuated dramatically, the population of clownfish has remained stable over the last ten years since Dr Mills began her research there, which is reassuring. This could have something to do with the way anemones recover from bleaching. They seem to recuperate much better than coral, thereby continuing to provide the clownfish with somewhere to live. Other coral-reliant fish don't fare so well with species of coral which can't recover from bleaching so easily. Dr. Mills is currently investigating whether the tight symbiosis with clownfish actually makes the anemones more resistant to bleaching or helps them recover more easily.

MORE EGGS

Clownfish can first reproduce at around 1-1.5 years of age, but lay relatively fewer eggs during their first few reproductive years. Older anemonefish lay considerably more eggs than their younger counterparts up to and over 3000 in a single bout.



Red Sea Clownfish
(Amphiprion bicinctus)

Dr Mills proposes another way to supply the pet trade which would protect reproductive adults.

"Instead of collecting adults, if it were possible to promote the collection of eggs from the wild to be hand reared in captivity and then sold when they are big enough – that would be a much more ecologically friendly and sustainable way to supply the pet trade. It's certainly in the Government's best interest to protect the clownfish, not least because tourism is the largest economy in French Polynesia. If the hard work of collection and hatching of clownfish was subsidised then that would be a win-win situation."

Clown fish waste products are good for the anemone

The symbiotic relationship between clownfish and anemones is fascinatingly complex. The waste products produced by the clownfish contain nutritious nitrogen resources such as ammonium which the anemone relies upon. It's been found that the more clownfish there are living in any given anemone, the faster the anemone will grow.

Dr Mills is also interested to find out if the mucus which surrounds and protects the clownfish from the anemone's sting contains a range of bacterial flora which is also good for the anemone's health and growth. Whatever the answer, it's clear that the relationship between anemones and clownfish is more complex than we currently understand.

Humans might help with clownfish conservation

Dr Mills' work researching the stress response of clownfish could eventually help conserve the species. By understanding which fish produce robust offspring, scientists might be able to produce and release more of these hardy fish which are more likely to survive. "This is already being done with coral reef regeneration. Scientists are finding the corals which are not affected by bleaching, taking a small bud from them, growing them and then implanting them back onto the reef to continue growing and living there. It's a process that's being called 'human assisted evolution' – something which could be helpful to the protection of clownfish too. Their stress response, offspring size and ability to deal with environmental stresses could be key to the species survival."

Scalloped Hammerhead Shark
(*Sphyrna lewini*)

Sharks!

"Although clownfish are a passion, my all-time favourite experience was when we were diving near Madagascar off the coast of a nearby Island called Europa. One of our party was a shark specialist who spotted a single fin breaking the surface of the water some distance away. He knew we might had come across a school of hammerhead sharks and invited us all to dive with him to see them close up. There were a few researchers on the boat, but I was the only one brave enough to go with him. And I'm so glad I did. As we got near we found that there were literally hundreds of hammerheads, just gliding along in the water beside us, breath-taking! – hammerheads as far as the eye can see going deeper and deeper. My heart was beating so fast. It was such a fabulous experience and one I'll never forget."

CRIOBE

The Centre for Insular Research and Observatory of the Environment (CRIOBE), was established in 1971 by France's National Centre for Scientific Research (CNRS). It began as a modest research station on the island of Moorea, French Polynesia, to research French Polynesia's coral reefs prior to the nuclear testing in the region.

Since this time, CRIOBE has evolved and grown considerably. Today, CRIOBE is a world class research centre with two locations: Moorea in French Polynesia and within the University of Perpignan in the South of France and hosts researchers, administrative staff and technicians from CNRS, Ecole Pratique des Hautes Etudes (EPHE), PSL Université Paris and Université de Perpignan Via Domitia (UPVD)

CRIOBE in Moorea French Polynesia is an international field station that welcomes researchers from around the globe. Research conducted at Moorea is primarily focussed on the coral reefs of French Polynesia, but also addresses the interface between the land and the sea.

2021 marks the organisation's 50th anniversary.

Dr. Suzanne Mills