Modern coral reefs harbour a large number of cryptic species: species that are either small and/or well hidden in the nooks and crannies of the reef framework. Examples include certain fish, stomatopods, shrimps and crabs. One such group consists of members of the Cryptochiridae family or cryptic crabs. These are small, usually much less than 10mm carapace length, and fragile, because much of their exoskeleton is poorly calcified.

The phylogeny, systematics and ecology of these crabs have been an active field of research during the last few years, especially due to work of Sancia van der Meij (Naturalis Biodiversity Center, now at the Oxford University Museum of Natural History) and colleagues. The number of living species known has increased notably from about 45 in 2011 to 52 species in 2016. Along with the discovery of new taxa of these cryptic species, the placement in the Grapsoidea superfamily has been rejected and the Cryptochiridae are now firmly placed in the Cryptochiroidea superfamily.

This group relies heavily on corals for protection, because all species live in domiciles within corals. Most of them can be found in circular to oval or crescent-shaped holes or pits (Fig. 1), whereas only two species make true galls in which the females reside. All species that live in holes are oriented face-forward. The holes are probably caused by a combination of the crabs’ ability to kill a polyp and plus subsequent removal of some coral by an unknown mechanism and the growth of the coral around the crab over time.

The hole shape of most modern cryptic crabs is known, but oval to circular holes are impossible to recognise in fossil corals, because such holes can also be made by a variety of other boring organisms, including some barnacles, sponges, bivalves, gastropods, shrimps and even other crabs. On the other hand, crescent-shaped holes are made exclusively by the cryptic crabs.

First fossil evidence

The latter is useful because fossil corals may preserve such holes, whereas the small, fragile crab has a much lower preservation potential. In fact, no unambiguous fossil cryptochirid body fossil has ever been found, nor any trace or hole until very recently. An Eocene species described in 2015, based on carapaces and initially included in the Cryptochiridae, was put in its own family within the crabs in March 2016. Domiciles in fossil corals were first recognised by Roger Portell (Florida Museum of Natural History) after an amateur palaeontologist found a coral specimen. This trace fossil species

Fig. 1. Modern cryptochirid crab in a crescent-shaped hole in a coral: (A and B) Troglocarcinus corallicola in the coral Manicina areolata. Scale bar = 5.0mm for (A); 50mm for (B). Photos: Sean Roberts.

Fig. 2. Manicina areolata with two crescent-shaped pits from the middle Pleistocene Bermont Formation in Florida: (A and B) views of entire coral; (C and D) close-ups of both crescent-shaped pits. Scale bar width = 50mm for (A and B); 10mm for (C and D). Photos: Sean Roberts.
was named recently after Richard Duer, whereas the new trace fossil genus honours the American science fiction franchise, Battleship Galactica: Galacticus duerri.

Subsequent to the first discovery, several even more crescent-shaped holes were discovered in corals from the Pleistocene of Cuba and the Pliocene and Pleistocene of Florida (Figs. 2 and 3). The 11 pit-bearing corals in total were of various forms - from massive to branching. Not surprisingly, bigger corals contained more crab holes. Occurrences of these holes were not found in every collection, but targeted field work in Florida by Roger Portell suggested that a couple percent of all fossil corals contain such holes. The corals need to be well preserved and reasonably clean, and you need to look at the hole straight on to see them.

More discoveries?

Hopefully, the first report of these holes in fossil corals is not the end of the story. Many more fossil corals should contain them. I looked at the global biogeography of crescent-shaped holes made by modern Cryptochiridae. They occur not only in the Western Atlantic, but also in the Eastern Pacific and Eastern Atlantic, and especially in the Indo-West Pacific (Fig. 4). As many as nine species create crescent-shaped holes in corals today in the latter region, although this number may be higher due to lack of research and the fact that domicile shape is not known for every species of the family.

I hope that more people will take a look at their fossil corals and recognise and report on these crab domiciles. This would help tremendously in constraining the antiquity of this crab family. Molecular estimates suggest an Early Cenozoic origin, and only fossil evidence can support or reject this hypothesis. Can you find new examples in your fossil coral collection or the collection in a nearby museum?

About the author

Adiël Klompmaker is currently a postdoctoral scholar at the University of California, Berkeley. Most of the presented research was carried out when he was a postdoctoral researcher at the Florida Museum of Natural History at the University of Florida.

Further reading: