Fish Eating Bubble Cone Shells

Cone shell is the common name for members of the Molluscan family Conidae, and there are several hundred different species worldwide. Kwajalein Atoll is the home to about 80 different kinds of cones. Cones are important in any discussion of dangerous marine life because first many have attractive shells and are likely to be picked up by a diver, and second they are equipped with armament that sometimes can be dangerous to humans.

Cones are all carnivores, feeding on other living animals. Most of the species eat different kinds of worms; some eat the animals out of other seashells; and some feed on fish. This article covers one group of fish-eating cone shells commonly referred to as the "bubble cones." The four bubble cones found in this area are shown at right; clockwise from left, they are *Conus geographus*, *C. tulipa*, *C. bullatus*, and *C. obscurus*. The rest of Kwaj's fish-eating cone shells will be covered later.

It is probably not difficult to imagine a snail being able to catch a slow-moving worm or another kind of snail. But how can a snail catch and eat a potentially much faster fish? The answer lies in the venomous teeth.

The teeth of a snail form a structure called a radula. Depending on the kind of snail, these radulae (plural) can have a variety of different shapes. In many families of seashells, such as cowries, the radula is composed of a row of hooked teeth on a ribbon-like structure that supports numerous rows of teeth. In a snail that grazes for a living, the animal scrapes this ribbon of teeth across the surface of a food source such as algae or sponge, ripping off bits of food and dragging them into the mouth.

In cone shells, the radula has become quite specialized. Individual radular teeth are elongate and pointed, often with barbs or hooks that make them look something like a whale harpoon. These teeth are held together in a radular sac much like a quiver of arrows and can be delivered one at a time to the organ that shoots it into a prey. Furthermore, the tooth being used connects to venom glands that deliver their paralytic neurotoxin up through a tube in the tooth and into the body of the prey. The drawing at left is a single radular tooth, plus an enlargement of the tooth's business end, of *Conus bullatus*, one of the bubble cone shells discussed below. The barbs near the tip help hold the prey while the venom does its work. The cone shell is able to hold onto the end of the tooth by the swollen bulb at the bottom to keep the fish from slipping away in any dying spasms.

The harpoon is delivered to the prey via a tentacle that extends from the mouth at the anterior end of the shell's aperture. We don't have a photo of the stinger of a fish-eating cone, so the shot of the mollusk-eating *Conus textile* at right will have to do. The red-tipped black and white banded tube coming out of the anterior end is harmless; it is just the siphon used by the cone to draw water into the shell, where it flows over the gills to provide oxygen. The reddish tentacle beneath it extends from the animal's mouth and delivers the stinger.

Therein lies the danger to humans. A person who picks up a living cone shell could be harpooned by that cone. What happens next depends on the kind of cone shell being handled.

The venom used by cone shells varies among species. It would seem that the venom has probably evolved to be most effective against the prey a particular species of cone eats. For cones that eat worms, the venom, if it is even used, would be effective against worms but maybe not if used on fish. In fact, it is thought that many worm eaters do not even use their harpoons or venom if the prey can easily be caught and ingested without them. Mollusk eaters' venom is probably most active against mollusks, although there have been reports of people injured or even killed by at least one mollusk eater. Mollusk-eating cones tend to be ones with tent-shaped markings on their shells (such as the *Conus textile* above), so one should take care with them. Mollusk-eating cones will be covered in another of these missives.

The cone shells people need most to watch out for are the fish eaters. There are several reasons for this. First, fish eaters tend to be more active and quick, since they eat potentially more mobile prey (although they admittedly do most of their hunting at night). Because of this, they seem likely to be more aggressive when picked up by a diver. Second, their venom has evolved to be effective against fish, which are vertebrate animals a lot more closely related to us divers than we are to worms or snails. Furthermore, the venom potency is likely to be greater due to the need to quickly subdue by paralysis or death the prey fish that is harpooned. And this increased potency makes it more likely for the venom to affect us. There is no antivenin for cone shell stings as there often is for snake bites. Snake venom is usually composed of only one or a few different toxins so an antivenin is not too hard to develop. Cone venom, on the other hand, can have in excess of 50 different toxins, which makes it much harder to develop an antidote.

The danger here is not all theoretical. As long ago as 1963, Dr. Alan J. Kohn documented 37 known cases of cone shell stings, of which 10 were fatal. Of the latter, five were reportedly done by the fish-eating cone *Conus geographus*; two by the mollusk eater *Conus textile*; and three by cones that were not at the time identified. It is worth noting that in the past, *Conus geographus* has sometimes been misidentified as *Conus textile*, so there is a chance that the initial reports could have been in error and all deaths may have been the former species. A more recent report

in 2000 on the Conch-L Listserv by Masashi Yamaguchi indicated that there were six confirmed fatalities in Okinawa alone, and a few more in the northern Ryukyu Islands.

Even the nonfatal cases can be bad. In a cone-stinging incident, the sting can be followed within minutes by numbness, tingling, burning, and blockage of blood flow to the area. A serious sting may result in nausea, headaches, generalized paralysis, coma, and respiratory failure within hours. Death usually occurs through paralysis of the diaphragm or cardiac failure. *Conus geographus* stings may produce rapid swelling of the brain by fluid uptake, coma, respiratory arrest, and cardiac failure. Even if one survives a serious sting, symptoms may take several weeks to resolve.

Significant research is underway on cone shell venom, since it has been found that some of the components are proteins that have enormous potential for use as pain-killing drugs. It turns out that some of these venom components target specific human pain receptors and can be thousands of times more effective than morphine as a pain killer without morphine's side effects. Of course, this is not to suggest anyone go looking for the nearest cone shell to get rid of that migraine. Tests on cone venom are still being done, and if cone venom is ever medicinally used on humans, its components would have to be properly isolated and processed first.

The remainder of this document identifies and illustrates the primary species of fish-eating bubble cone shells you could encounter here.

First and foremost is what is considered the most dangerous cone shell, the geography cone *Conus geographus*. It is the largest of the bubble cones found here, growing up to about 6 inches in length. *Conus geographus* and the bubble cones in general tend to be more cylindrical than straight cone-shaped. They usually have relatively thin, lightweight shells and large animals that bulge out of the shells' apertures. The geography cone is the species implicated in most human deaths, and it is the most aggressive of the bubble cones. When disturbed, many cones will retract their animals into their shells. *Conus geographus*, on the other hand, tends to stretch out of its shell when disturbed, often protruding its stinger and waving it around looking for something to sting. Contrary to popular belief, there is NO WAY you can hold a living geography cone shell with your bare hand and be fully protected from the sting; the tentacle that delivers the harpoon can stretch all the way around the opposite tip of the shell. It's best to leave these alone, but if you ever pick up a living specimen, do it from the wider end and carefully watch it the entire time for activity around the mouth end. In the photo at left, the siphon extends from the anterior end of the shell (the right side of the

photo) and the mouth is barely visible just to the left and slightly lower. Just a bit farther left, the smaller white tentacle bears one of the animal's black eyes. If a tentacle comes out of the mouth, drop the shell immediately! These cones are most often found at night, when they are out hunting for sleeping fish. They can be found in a variety of habitats on lagoon or oceanside reefs. Some years ago, on a club-sponsored night dive at Emon Beach, a woman came out of the water with one of these and was reportedly letting it crawl around on her hand while showing it off. THAT was dangerous!

Interestingly, the radular tooth of *Conus geographus* does not have pronounced barbs like that shown earlier on the radula of *C. bullatus*. This may in part be related to its fast acting venom that prevents the prey from breaking away, but much is apparently due to the hunting technique of this particular cone. It has been observed to, instead of stinging right away, expand and extend its mouth fully around a sleeping fish, much like catching it in a net. Then it can sting and subdue the prey without it being able to break away. These guys can be pretty fast!

The second of the fish-eating bubble cones is *Conus tulipa*, the tulip cone. While this cone does not grow as large as and seems to not have quite as aggressive an attitude as *Conus geographus*, it is potentially as or more dangerous. While *Conus geographus* is rather uncommon and found only subtidally, *Conus tulipa* is relatively common intertidally and can often be seen out on the reef between Kwaj and Little Bustard at low tide. The largest specimen recorded from this area was a bit over 3 inches. We know of no reported deaths worldwide from this cone, but it is worth being very careful with it.

A third bubble cone is *Conus bullatus*, an extremely rare cone here at Kwaj. We have seen only a few broken fragments and an empty shell that washed in on the reef at Bigej that measured about 2½ inches. We know of two living specimens, both found quite a few years ago: one was on the intertidal reef just south of Meck Island and the other came from the salt water intake area on the oceanside of Kwaj near the hospital. Unlike the other bubble cones, this one usually has a rather thick and heavier shell. It is a low-risk cone only because it is so rare; as a fish eater, a living specimen is potentially dangerous.

The last of the local bubble cones is the small *Conus obscurus*, found fairly commonly in rubble or crawling about at night on the oceanside dropoff. One would hope its small size, up to about 1½ inches but usually an inch or less, would make it less dangerous than the others, but it is still a fish eater. The photo at right below looks directly into the anterior end of this cone, showing

the folded siphon tube at the end of the aperture, with the slightly puckered mouth just below it, flanked on both sides by a white, eye-bearing sensory tentacle. The stinger would come out the mouth.

There is a report of a shell collector in Hawaii being stung by a dead *Conus obscurus* while the shell was being cleaned. Although the shell had been frozen and thawed, its sting still caused a fair bit of pain and swelling.

There is a remote chance a diver could get stung by a cone by putting his or her hand in the wrong place on a night dive. But it is more likely to be stung by handling live cone shells, although even that probability is very small if the diver is aware of the potential danger and practices reasonable caution. It is not that you can never safely touch these things—just be careful if you do.

Next month: the remainder of the fish-eating cone shells.

Reference:

Kohn, A.J. 1963. Venomous marine snails of the genus *Conus*. In: *Venomous and poisonous animals and noxious plants of the Pacific area*, 83-96. Keegan H.L. and Macfarlane W.V. (Eds). Pergamon Press, New York.

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