Shell of the Month

by Dr. Rick Batt

***Nautilus pompilius* Linnaeus, 1758**
(Chambered Nautilus)

The Chambered Nautilus is a member of the family Nautilidae, the only living group of cephalopods that have an external shell. This family is all that remains of a long lineage of nautiloid cephalopods that originated back in the Cambrian Period, more than 485 million years ago. Nautiloid shells are superficially similar to those of ammonites, members of a more advanced group of cephalopods (ammonoids) that became extinct at the end of the Cretaceous Period about 66 million years ago. Because today's Nautilus is the only modern analog for comparison, when I pursued my Doctoral research on ammonites I also needed to become an "expert" on all aspects of modern Nautilus.

The shell of a Nautilus is composed of the mineral aragonite (nacre), which gives the shell's interior its pearly luster, which can also be exposed by dissolving away the outer layer of the shell in acid to produce the "pearly Nautilus" shells common in shell craft. The Nautilus shell is coiled in a single plane (planispiral), with earlier whorls hidden or nearly hidden by the final whorl (we call these shells "involute"). The first picture shows two views of a typical Nautilus shell (US quarter for scale).

The shell's interior is divided into a series of chambers separated from each other by septa (singular "septum"). The second picture shows a Nautilus shell that has been sawed in half to show the internal details. The animal occupies the large living chamber at the end; the older part of the shell behind the last septum is called the phragmacone. The chambers are connected by a tube called a siphuncle, through which the animal can regulate the relative proportions of water and gas that fills them. Delicate adjustments of these proportions allow the animal to maintain neutral buoyancy, hovering suspended in the water without rising or sinking.

In all species of Nautilus the shell color is white with reddish-brown stripes extending across the venter (curved outer edge of the shell) and partway or all the way to the umbilicus (center of the coil), which may be covered by a callus buildup. In juvenile shells the stripes are found all the way to the aperture; but in adult shells they are found only partway along the final whorl. Adult shells of *Nautilus pompilius* are typically between 150 and 200 mm (6 to 8 inches) in size, but can reach about 250 mm (ten inches).

Nautilus are the most primitive of living cephalopods, with primitive eyes lacking a lens (comparable to a pinhole camera) and about ninety relatively short tentacles surrounding a mouth that bears a chitinous beak. Even though they can maintain neutral buoyancy to hover within the water column, Nautilus typically remains close to the bottom where they feed upon crustaceans and scavenge for dead animals. Nautilus often inhabit deep water (depths up to 500 meters) during the daytime, but will migrate to shallow depths in reef areas at night to feed, using jet propulsion through a funnel to swim since buoyancy adjustments take too long.

Today, all species of Nautilus are restricted to the western Pacific, found from off the coasts of Australia north to Japan and east to Micronesia. All species have recently been added to the CITES list (Appendix 2) to protect them from the massive trade demand.

How many species of Nautilus are there? The answer depends on whom is being asked. According to some, *Nautilus pompilius* is only one of more than six species in the genus *Nautilus* (a new one from Fiji has just been described and named). There is now also a second genus in the family: *Allonautilus* ("other Nautilus"), with one (or two depending on whom is asked) species with a less involute shell and relatively flat sides. However, according to many of us who have experience with Nautilus, there are really only two distinct species of *Nautilus* (*N. pompilius* Linnaeus, 1758 and *N. macromphalus* Sowerby, 1849 from New Caledonia), and one species of *Allonautilus* (*A. scrobiculatus* (Lightfoot, 1786) from the Solomon Islands with a form called *A. scrobiculatus perforatus* (Conrad, 1897) from Bali. All of the other named "species" of *Nautilus* would then be subspecies, or even simply geographical variations, of *Nautilus pompilius*: the differences in the shells, if any, as well as in the animals themselves do not appear to be sufficient to warrant species designation. These forms of *Nautilus pompilius* include: *suluensis* Habe & Okutani, 1988, a dwarf form from the Philippines; *belauensis* Saunders, 1981

from Palau; *repertus* Iredale, 1944 from Indonesia; *stenomphalus* Sowerby, 1848 from Australia; and the newly named *vitiensis* Ward & Barord, 2018, a dwarf form from Fiji.

The next picture shows several of the forms of *Nautilus pompilius* in my collection: look for the differences. First row: typical form from the Philippines (185 mm); *suluensis* from the Philippines (100 mm); *belauensis* from Palau (237 mm). Second row: *repertus* from Indonesia (202 mm); *vitiensis* from Fiji (142 mm); and a specimen from Western Australia (229 mm) that looks very similar to *stenomphalus* from Queensland. The final picture shows: juvenile specimen of *Nautilus pompilius* from the Philippines (84 mm); albino specimen of *Nautilus pompilius* from the Philippines (160 mm); *Nautilus macromphalus* from New Caledonia (150 mm); *Allonautilus scrobiculatus* from the Solomon Islands (two specimens, 190 mm and 175 mm); and *Allonautilus scrobiculatus perforatus* from Bali (178 mm).