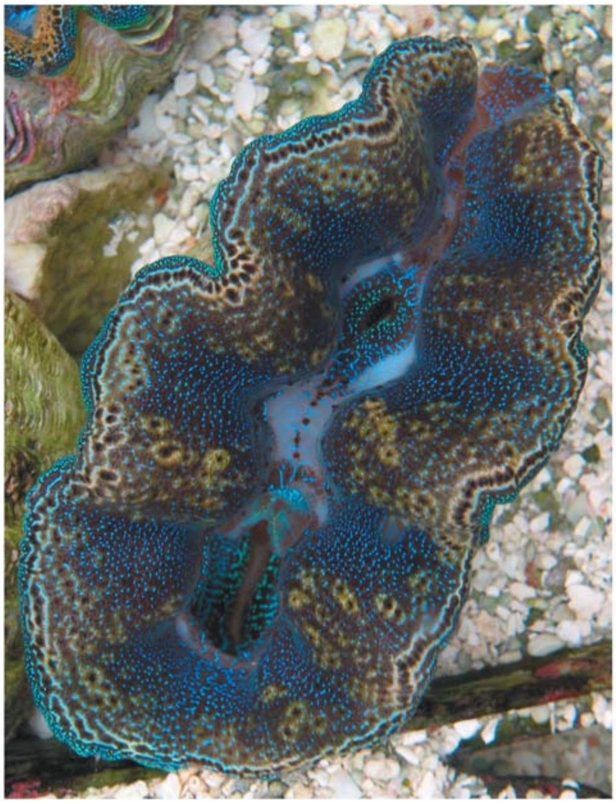
Giant Clams
Family *Tridacnidae*




Tridacna crocea - The smallest Tridacnid species. One of the most Tridacna gigas - The largest Tridacnid species. Legendary colorful, variable and sought after Tridacnids, T. crocea rarely sightings peg T. gigas at nearly six feet in length, although 4 feet exceed 6" (15cm) in length and is commonly known as the "Boring is quite a remarkable specimen and not entirely uncommon. Clam" for the ability (and preference) to mine a residence in hard The age of such living wonders is awesome… perhaps well
carbonate reef structures. (L. Gonzalez) over 100 years old. This one photographed off Queensland, Australia.

There are at least seven *Tridacna* species and two *Hippopus* species in the sub-family Tridacnidae. In the genus *Tridacna*, five are offered in the aquarium trade: *T. crocea*, *T. maxima*, *T. derasa*, *T. squamosa* and *T. gigas*. Among the species of interest to aquarists, Tridacnid clams are found over a very wide range of depth - from lagoon-shallow water to more than 45 feet (the rare *T. tevoroa*, however, is found at amazing depths approaching the limits for zooxanthellate-symbiotic animals). Species are also found in niches running the gamut of water turbidity from muddy to pristine clarities. As such, the dependency of these animals in captivity on lighting and supplemental feeding to algal-symbiotic activity (feeding organismally and by "absorption") ranges accordingly. With further consideration for differences in hardiness and sensitivity due to shipping and acclimation, it becomes apparent that a categorical assessment of husbandry for the subfamily as a whole in aquaria cannot be proffered.

Selection: Choose Captive Produced vs. Wild-Collected

Most of the Tridacnid clams found in the ornamental trade are cultured, although some wild-harvested specimens are unfortunately still collected from reefs. Aquarists will want to make a concerted effort to acquire cultured specimens preferentially. These animals are much more likely to excel; they are easier to acclimate for having been farmed in captive conditions and transported with fewer traumas

(e.g. handling, transit time, water quality, etc). Contrarily, progress from the point of collection through the chain of custody on import for wild-harvested animals is often burdened measurably. This leads to stressed clams offered at inflated prices to compensate for the categorically higher mortality

Left: **Tridacna derasa**, at a retailer in San Diego. This 10" individual might be only a few years old! (L. Gonzalez)

T. maxima -Tridacnids develop a fabulous range of colors and patterns, even within the same species. These are small maximas at a retailer. (L. Gonzalez)

imposed upon them. Some of the problems with wild-harvested clams include: increased likelihood of damage to sensitive adductor muscle tissue from improper collection, increased likelihood of parasitic organisms (like "pyram" snails… the Pryamidellids), and weakened condition on import from poor water quality due to fouling organisms that commonly travel attached to clams (many sponges and other sessile invertebrate growth forms do not weather transit well). Some aquarists feel as though wild clams are prettier, but this is not true. Wild clams are less likely to be graded and cherry picked on import in contrast to cultured clams that are necessarily sorted and graded. The fact of the matter is that aquarists who are willing to pay a premium for the more desirable mantle colors drive some markets. As such, an American aquarist is less likely to see or pay such a premium for the highest grade clams while Japanese aquarists, for example, are willing to pay handsomely for these favored varieties.

Selection: Criteria

When selecting Tridacnid clams, many of the above considerations come into play and our recommendations reflect the realities of importing live clams that may not be readily apparent to an aquarist. One of the first things that a buyer should look for in a healthy Tridacnid is alert and responsive behavior. While some species and larger specimens in general can be somewhat slower to respond to a passing shadow overhead, all should respond promptly to such disturbances. Lazy or non-responsive behaviors often indicate a stressed animal. In a similar vein, a "gaping" clam indicates a serious and often fatal condition. **"Gaping"** is indicated by a stretched appearance or splaying of the animal's shell halves, as well as the inhalant siphon (the larger opening on the mantle of this filter-feeder) appearing to be open particularly wide and non-responsive. Quite

T. maxima -with internal organs visible, an example of stress-induced gaping (L. Gonzalez)

frankly, it is symptomatic of the last stage before death for many specimens. It does not, however, indicate any specific condition and can be caused by prolonged siege by predators like pyram snails, saline or luminary shock, severe trauma to adductor muscle and/or internal organs, and more.

Additionally, when selecting a Tridacnid, its **mantle** (the colored fleshy lobes extending to and beyond the top of the shell) should be fully extended and its color should be rich, dark and crisp indicating a healthy population of resident zooxanthellae (symbiotic algae). Individual "bleached spots" in the color of the mantle, or pale

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color overall, indicates problems with the life-supporting symbiotic algae. Clams, like coral, that have expelled their zooxanthellae are stressed and struggling animals. For such specimens to reach their compensation point for survival and ultimately recover, regular feedings may be necessary. Clam feeding is best and most likely done with the finest food suspensions if not exclusively with a dissolved nutrient (more about this below in the *care* section).

Another unusual symptom to look for in Giant Clams is **gas bubble disease**. It is amazing just how easily this deadly condition can be induced. Gas bubble disease is indicated by hidden air bubbles trapped in the tissue of a clam. This gas can even make small specimens buoyant! Similar to the dangerous nitrogen bubbles sometimes experienced by rapidly surfacing SCUBA divers, this problematic condition is caused by supersaturated atmospheric gasses escaping solution within the very tissue of the animal. In aquaria, this is most often induced by pouring hot water into cool water, sometimes done when making buckets and baths for acclimating animals (a very dangerous way to quickly make warm water). The condition is also created by the pinhole aspiration of air (as with a leaky fitting) into a water pump or plumbing, causing the supersaturated condition. These causative agents are easily prevented, identified and remedied, however the condition in the living

animal is serious, and there is no therapy available to the average hobbyist.

Scrutinizing the shell and mantle of a Tridacnid is also crucial when selecting a specimen. The very structure and texture of many bivalve shells is intended to attract incidental organisms to settle and live as camouflage. In shipping, hitchhiking organisms like algae, sponges and other invertebrates can easily foul, leading to stress or death of a clam. Some Tridacnids are more inclined than others to attract such growths by virtue of their attractively exaggerated **scutes**. *T. squamosa* is perhaps the most interesting if not attractive Tridacnid in this regard. In many cases, when such co-imported sponge growth is allowed to remain on the clamshell, the sponge can, over time, grow to the point of impeding available water and light to the clam's mantle. Some algae and sponges are in fact boring (as in drilling, not yawning) species that can be quite destructive -mining fatal holes straight through to the clam's body cavity. Be alert of suspicious pinhole formations on the shell that may indicate such harmful species. Once again, for these reasons and more, cultured clams with clean shells are better choices for aquarium display.

Clam Pests & Predators

Many pests and predators are attracted to Tridacnids. Boring sponges, segmented worms (errantiate polychaetes), crabs, predatory mollusks (snails) and flatworms are commonly caught preying on *Tridacna* and *Hippopus*. Most can be observed through careful observation and removed manually. Many can be prevented or protected against by founding Tridacnids on rock to protect their vulnerable byssal port (the opening on their underside through which byssal threads attach and secure the specimen). For clams placed upon a sandy bottom, a solid flat rock buried underneath is strongly recommended. Pyram, Murex and Costellarid snails often prey on such clams. The Pryamidellids are perhaps the most common, prolific and tedious, if not difficult, to eradicate due to their small size and camouflage coloration. Natural predators, such as smaller species of wrasses, can be helpful for reducing the population of such predators, but none can be assured of providing complete protection.

Pseudocheilinus hexataenia -The "Six-line Wrasse". A favorite predator of small snails and worms.

Halichoeres chrysus -The "Yellow Coris Wrasse". Also family Coridae (but not genus Coris!). Another great snail hunter, up to 5" (125 mm) fully grown.

The gelatinous and, at times, numerous egg masses of predatory snails require frequent re-inspections by an aquarist to detect and remove in order to maintain satisfactorily low populations. Large clams can safely sustain siege from a small amount of pyram snails for many months, but smaller clams can succumb in just a few days to weeks. Routine inspection of clams for some pests is *de rigueur* in systems that otherwise properly quarantine all new rock, coral and sand. It is absolutely required for all other systems run with less discipline. Monthly inspections for the first 3-5 months are suggested and quarterly after that. All things considered, the aquarist should allow four weeks for proper quarantine and screening of Tridacnid species. Many pests and predators of clams can be baited in a bare bottomed quarantine tank with pieces of food-clam from the local grocer or pet store freezer.

Bigger Isn't Always Better: Size Recommendations

Beyond aesthetics, clam size is an important consideration in price and selection. The potential adult size of a clam is often overlooked at the time of aqcuisition. *Tridacna gigas* can grow several feet in length and attains an extraordinary weight of many hundreds of pounds in as little as ten years. A responsible aquarist plans for the adult size of this magnificent animal just as one would do for a large family dog. It is not sensible or appropriate to keep the true Giant Clam in tanks of even a couple hundred gallons in size on the hopes and dreams of getting a bigger tank one day. *T. derasa*, *T. squamosa* and *H. hippopus* in suit reach impressive sizes approaching two feet in length. Due respect and consideration is required for keeping such animals. However, even with a suitable sized display tank, one must also be selective about the size upon acquisition for various species of clams. As a rule, very small and very large clams tend to ship, handle and acclimate poorly relative to smallish to intermediate sized specimens for a given species. For *T. crocea* and *T. maxima*, 2 1/2" – 4" (62-100 mm) specimens are generally best, stronger for shipping and acclimation. For all other Tridacnids - 3"-6" (75-150 mm) specimens tend to handle best upon import. Let these guidelines serve the aquarist well during information gathering as he/she attempts to make an informed buying decision based on an intelligent (hopefully!) consensus.

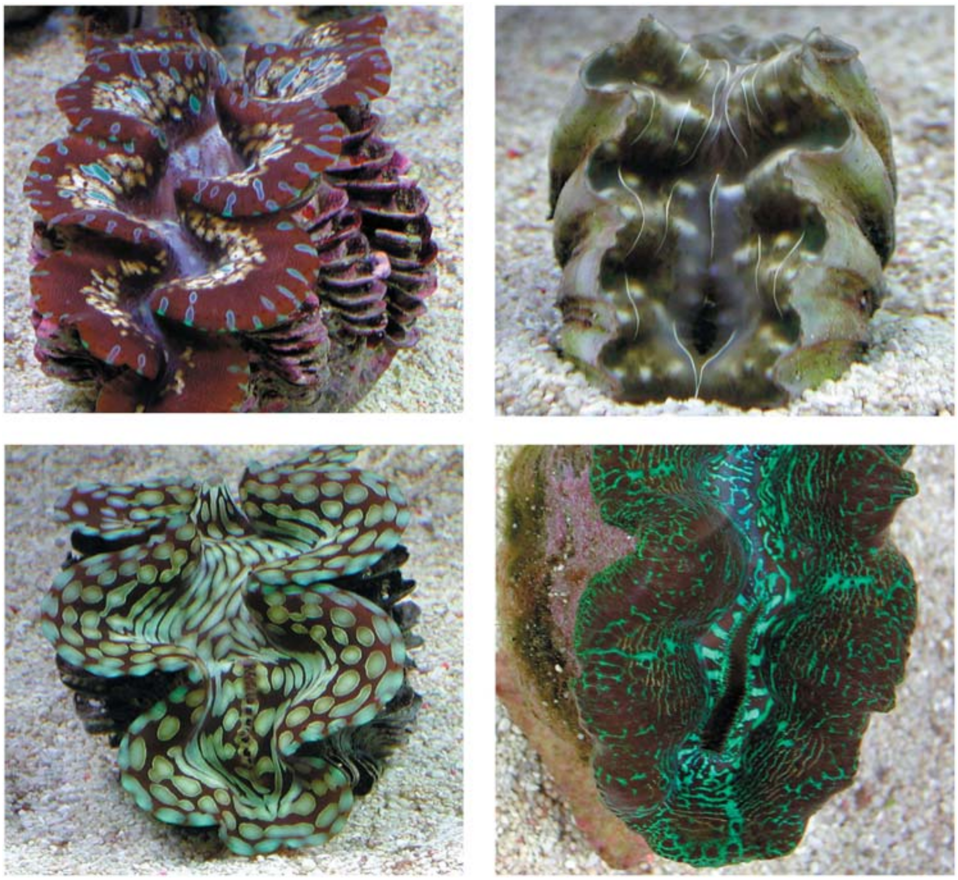
Clam Care: The A, B, C's

Care of Tridacnid species in captivity is rather straightforward once a healthy specimen has been selected and established. These clams are quite long-lived with natural life spans of decades. Tridacnids are largely symbiotic animals that can secure much of their sustenance from photosynthetic activity. The quality and intensity of artificial light provided them is therefore a matter of great importance. Numerous developments in lighting technology employed

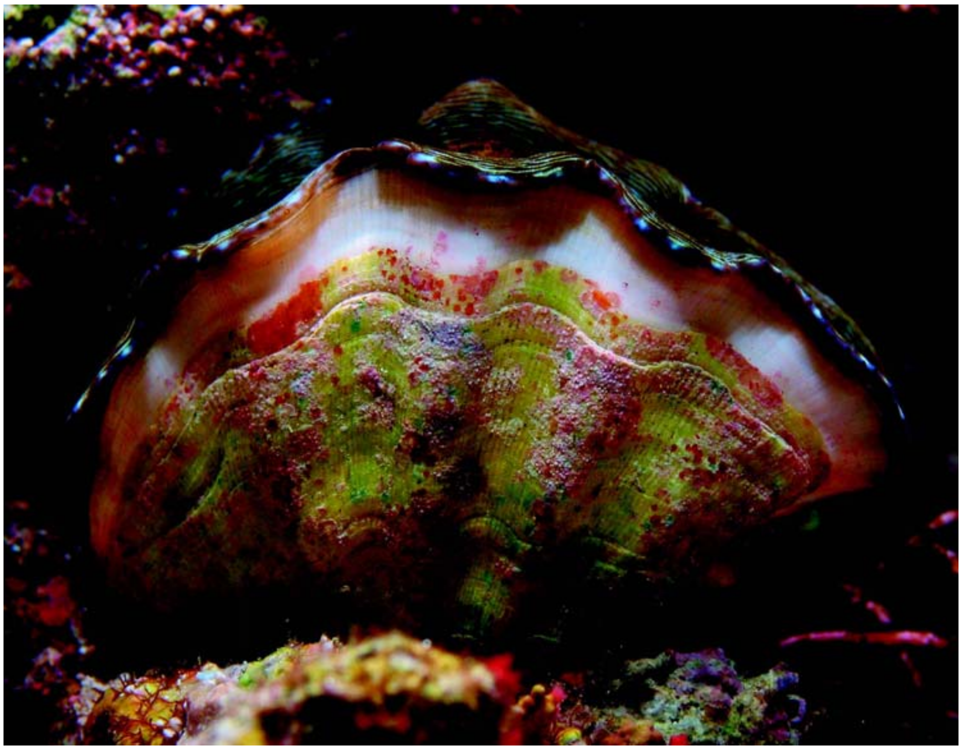
Summary of Selection tips for Tridacnid clams:

- Check for alert and responsive behavior to changes in light
- "Gaping" inhalant siphons indicate stressed or dying animals
- Mantle should be extended fully
- Pigmentation should be rich, dark and crisp indicating healthy symbiotic algae
- Bleached spots or overall pale color indicates stressed/ starving animals
- Beware of gas bubbles in tissue
- Look for holes in shell from boring organisms
- Look for pests and predators, their egg masses, or signs of damage particularly under mantle, between shell scutes and around byssal port (underneath clam)
- Intermediate sized clams tend to acclimate best to captivity

in keeping photosynthetically symbiotic animals has evolved rapidly in recent years and is sure to continue. Nonetheless, time-tested technologies are available now to recommend to aquarists intent on keeping Tridacnids. All symbiotic animals must acclimate to changes in light on arrival and clams have proven to be one of the most adaptable groups of reef creatures here. The very notion of a homogenized lighting recommendation for successfully keeping a subfamily of symbiotic creatures that runs such a wide gamut of exposures to light at depth and turbidity in the wild is testimony to their adaptability indeed. Lighting requirements for Tridacnids is rather akin to lighting necessary for popular species of shallow water so-called SPS corals (small polyped stony scleractinians). Their needs may be regarded as moderate to bright... leaning decidedly towards bright (intense). Under-illuminated clams will change color: often darkening at first in an attempt to cultivate more zooxanthellae with the purpose of trying to capture more of the diminished available light energy. In advanced stages, such clam's color will pale as zooxanthellae are expelled under duress by the starving animal. Supplemental feeding of dissolved nutrients (sources of ammonia/ nitrate) may stave off or delay the inevitable. Under-illuminated clams may survive in captivity for many months or even more than a year before perishing "mysteriously" (a mystery only to the aquarist that does not realize that illumination was waning or inadequate). Most clams are best kept under high intensity lamps like metal halide lighting. Bulb



Clockwise from top-left, **T. maxima, H. hippopus, T. crocea**, and **T. squamosa** in captivity. (B. Neigut)

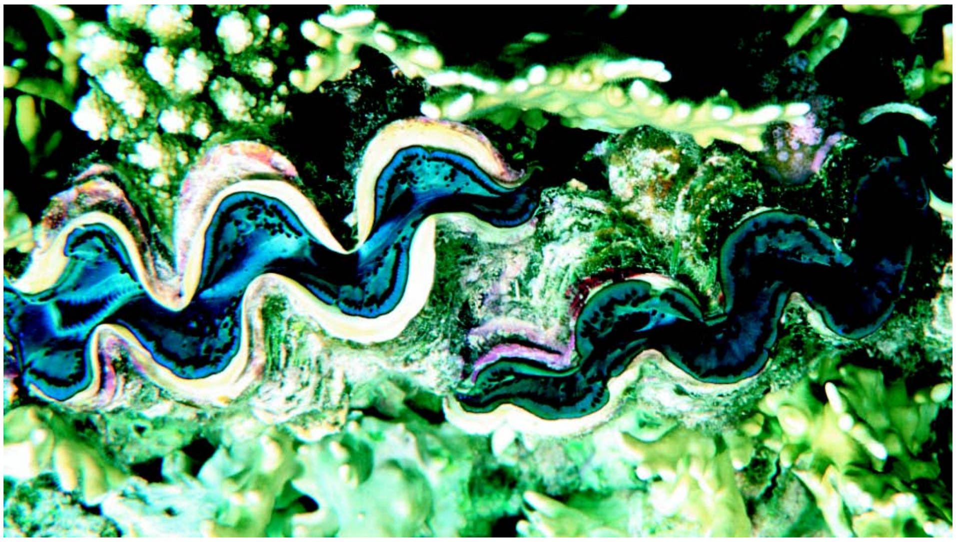


temperatures in the range of 6500K to 10,000K are ideal for Tridacnids and most popular corals in the ornamental trade. A 175-watt lamp per four square feet (2' X 2') will serve the purpose nicely in water 20-30" deep. Fluorescent lighting of various formats (PC, VHO) is fine and aesthetically attractive for shallow water environments less than 24" deep. When fluorescent lighting is utilized, clams should usually be placed in the top 18" of water. Acclimation of clams in very shallow water or under brighter lights (250 watt MH and higher) must be done with great caution and consideration, including starting the specimens at depth, and initially shielding/shading the specimens. Maintenance of good water clarity through consistent use of chemical filtrants and water changes, along with clean light intensity (lamps/covers free of debris and salt creep, and fresh lamps of high PAR delivery rotated regularly) is necessary for clams and all symbiotic reef animals.

Placement

Placement of clams is another simple but crucial matter of importance. As with hermatypic corals and like symbiotic animals, Tridacnid clams should be placed in a good spot the first time and left in place! Moving healthy and established animals throughout a display can impose tremendous stress as they try to compensate for the changes in lighting, circulation and proximity to other life. Repetitive moves of newly acquired animals within a matter of days or weeks can prove to be fatal. Aquarists are advised to research the clam's needs as best as possible, make informed decisions, and place them permanently the first time. Clams should be set upon a hard flat rock (burying the rock in the sand if necessary or desired) to reduce the risk of siege by predators through the byssal port and damage to vital organs. Water flow is a matter of somewhat lesser importance for Tridacnids so long as a few basic needs are met. As a filter-feeder, Tridacnids are dependant on adequate water flow bringing nutrients to them and carrying waste products away. Unlike corals though, they are not so directionally discriminating about the dynamics of water movement for growth or their very morphology. A moderate to high turnover of system water in random turbulent flow serves Tridacnid clams very well. Laminar (one direction) flow or affronts with direct streams of water is to be avoided. Aside from being unnatural, a directed stream of water might carry temporarily spiked additives or supplements in a stressful or fatal concentration around this filter-feeder. Clams are especially sensitive to metals in the water and they have been reported anecdotally to suffer from accidental local concentrations of spiked iodine when water movement in the tank was inadequate.

Large **Tridacna maxima** in the Red Sea.



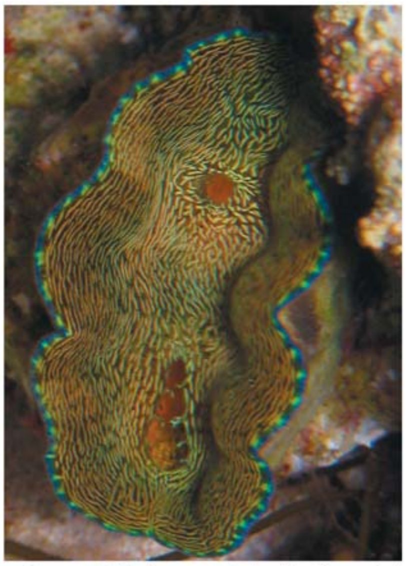
Left, T. maxima, middle a brown/black T. maxima, and T. derasa at right. (L. Gonzalez)

In summary, placement of Tridacnid clams is rather like the handling of most reef corals in captivity; they require confident and secure placement (on a stable flat rock) under moderate to strong random turbulent water flow. Another consideration when planning a display that will house Tridacnid clams is that they can shoot a stream of water up and out of the aquarium. You need to take into consideration the depth of your tank, the depth at which you will place the specimen, its adult size, and the distance between your lights and the surface of the water. These estimates will play an important role in several lighting decisions such as the intensity of the lamps you use, whether you place a cover on the aquarium, and whether or not you use a shield on the light fixtures themselves. Of course, you should always use fixtures that are designed for marine aquarium use. It would also be prudent, in the event that your fixtures do come into contact with saltwater (risking a short-circuit and/or shattered lamp), that the lighting system operate on a separate circuit than the pumps and other vital equipment. Careful planning will protect you and your livestock from a complete system failure.

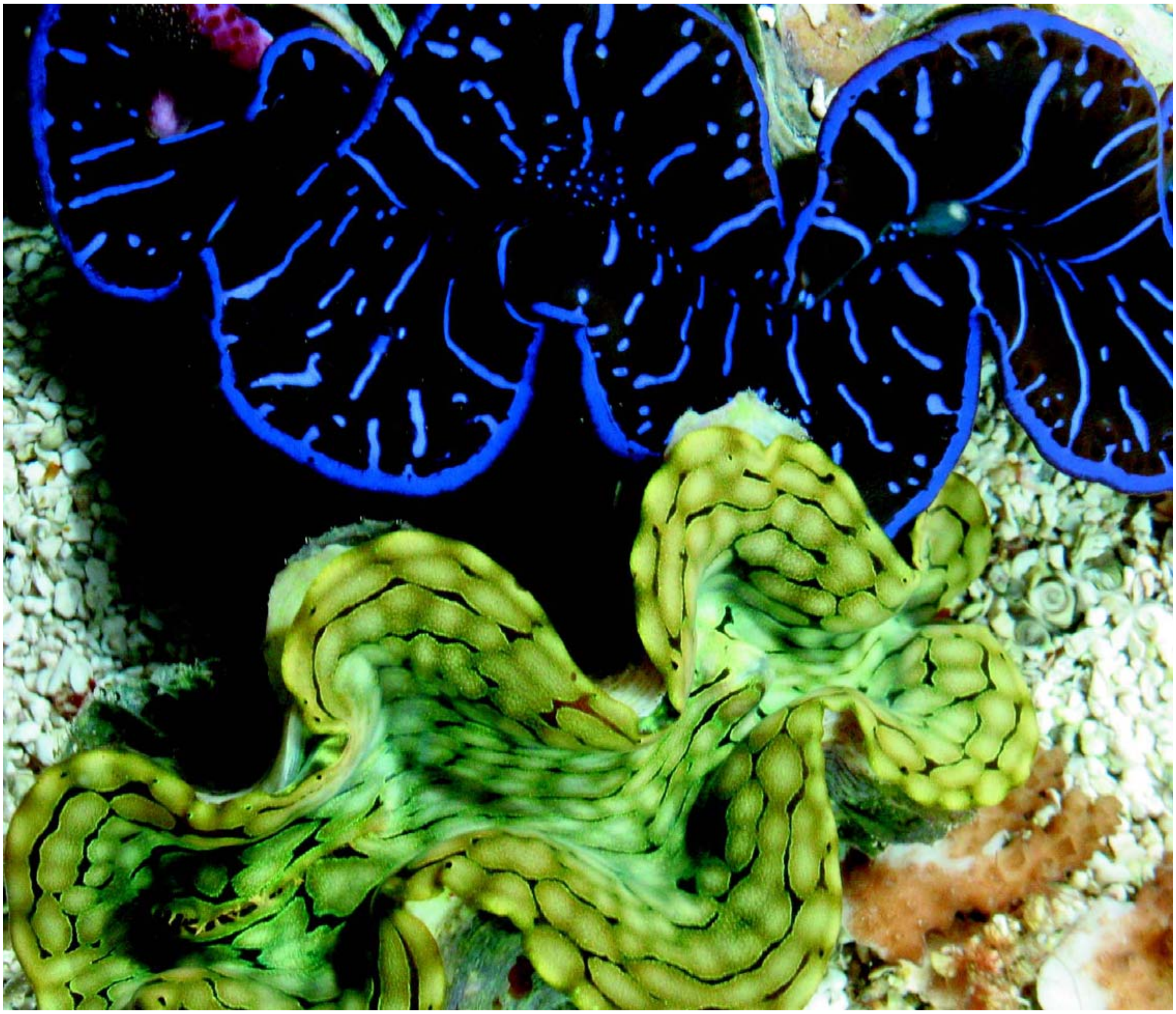
Feeding

Feeding Tridacnid clams is an often-overlooked aspect of their husbandry. They are filter-feeding animals that do indeed have a fully functional digestive system. As form follows function, it stands to reason that they must feed on something. Beyond nutrition derived from the products of photosynthesis from their hosted symbiotic algae, Tridacnid clams feed on very minute (“nano”) plankton. **Nanoplankton** particle sizes cannot be easily provided by aquarists, through traditional prepared food suspensions. In

squamosa - Red Sea.

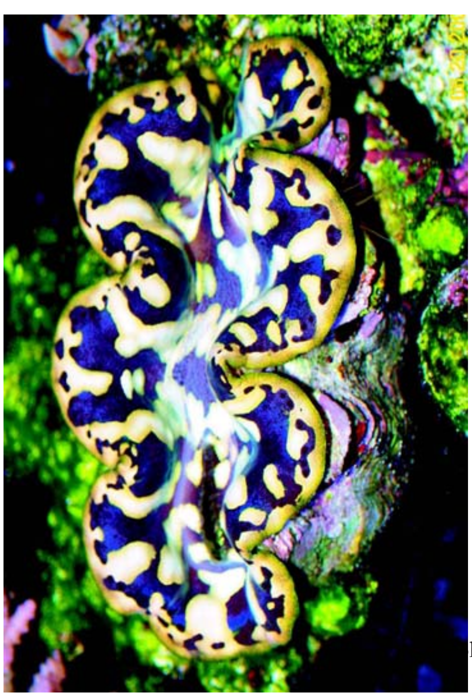


Left, *T. maxima,* middle a brown/black *T. maxima*, and *T. derasa* at right. (*L. Gonzalez*)



Top, **T. maxima**, bottom, **T. squamosa** in a "look-down." (L. Gonzalez)

fact, target feeding of any kind is very difficult to do with clams (especially smaller specimens). Larger particles of food will be collected and rejected from the clam with a sudden and disapproving expulsion like a cough! Clams instead need dissolved organics and the finest plankton (microscopic) on which to feed. Cultured specimens held in raceways are fed ammonium chloride just to maintain their active and growing metabolisms, a precarious and potentially toxic practice especially when employed



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on smaller systems. Clams that pale in color overall (uniformly) after an extended period of time in captivity may well be starving for a source of nitrogen. In aquariums that are aggressively filtered and skimmed, nitrate levels can be so low that endosymbiotic zooxanthellae in clams and corals begin to suffer, with waning color of the host as testimony to it. Some aquarists have tried to correct this deficiency by adding sodium nitrate in very small concentrations (.1% Knop, 1996). Adding ammonia and

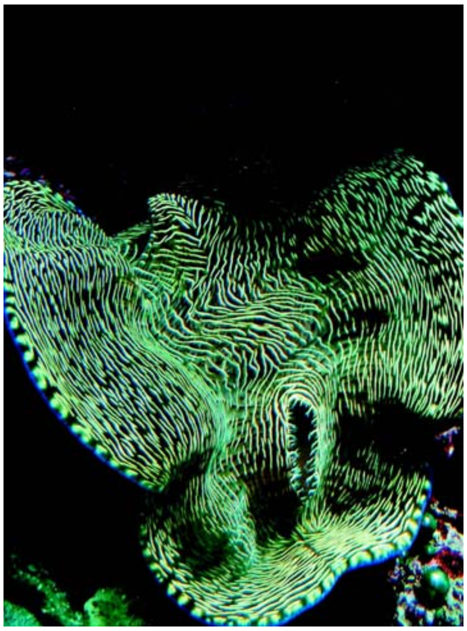
nitrate however can be a difficult or even dangerous endeavor for the casual reef aquarist and is not recommended for most.

Other alternatives for nanoplankton in aquaria include yeast and cultured phytoplankton (greenwater). Bottled greenwater is often touted as ideal clam food. However, even if Tridacnids feed on such products from a bottle, the necessary limitations of the food and its delivery are so strict that it is unlikely that much of it is useful. The reality of it all is that few aquarists are aware of the proper and necessary protocol

for preparing and offering bottled greenwater supplements to insure a fine and usable particle size. Bottled phytoplankton must be packaged, shipped and held under constant refrigeration: it should be purchased from a refrigerator and kept in a refrigerator. Ideally, the bottles will be dated and used within 6 months of production. Greenwater cultures clot with age and thus particle size can increase dramatically. Whisking with an electric blender may be necessary to reduce particle size to a hopefully usable measure for clams and corals; simply hand shaken greenwater is not remotely adequate for this purpose. Such restrictions to the successful application of bottled "greenwater" products are indeed tedious. Nevertheless, such products may still serve a useful purpose for aquarists that cannot or will not take steps to culture live phytoplankton. Live phytoplankton cultures that were formerly tedious to produce are nowadays simple to culture and harvest (see index of contacts for plankton culture kits/ supplies). Recent developments with so-called **phytoplankton**

reactors show great promise for the convenient culture and delivery of this elemental foodstuff to reef invertebrates and will likely help to unlock the mysteries of husbandry of many captive animals. Live baker's yeast suspensions are also nutritively dense (rich in vitamins and proteins) and likely beneficial to clams and some corals. However, they must be prepared with the same tedious methods as bottled greenwater described above. Regarding the applications of feeding, all such foods mentioned here are best delivered through a slow and extended drip, as clams do not respond favorably to sudden attempts at target feeding with a pipette or baster.

Large 18" **T. derasa** at the Shedd Aquarium in Chicago (L. Gonzalez)



Tridacnid clams in aquariums with high bio-loads from heavy feedings to various animals, including fishes, will undoubtedly benefit from available dissolved nutrients. Perhaps the best source of nutrition for clams is a large, mature inline fishless refugium. Refugia with seagrasses, containing rasping snails/mollusks, worms and more, with strong water movement can generate significant and useful amounts of epiphytic material and plankton. Refugium technology in its many forms and styles has been fully embraced by modern aquarists that are just beginning to understand and define the merits of such applications. And remember that there are *many* useful variations on refugium technology beyond the limited abilities of *Caulerpa* filled vessels. Judicious experimentation with a combination of the above listed feeding options will easily support thriving symbiotic clams under appropriate illumination.

Besides quality light and

Summary of Care for Tridacnid clams

- Provide moderate to bright lighting over shallow water for most Tridacnids. Power Compact (PC) or Very High Output (VHO) flourescent for water under 24” deep. Use Metal Halide or HQI for water more than 24”.
- Put the animal in a good place the first time and let it acclimate (Leave it alone!)
- Clams should be set upon a hard flat rock (or in sand on buried rock)
- Avoid placement or exposure of clams to direct streams of water that may carry temporary spikes of additives or supplements (iodine, metals)
- Any feeding of clams is best conducted with a slow drip/ continuous feed
- Fishless refugiums and phytoplankton reactors are natural food sources
- Ample & stable supplies of calcium and carbonates are necessary for growth

available nutrients, an aquarist must also realize the importance of maintaining adequate and consistent supplies of bio-minerals for calcification in Tridacnids. Indeed, consistency of water quality is of greater importance than reaching the high end of some idealized water chemistry. In this case, an alkalinity of 8-12 dKH and calcium ranging 350-425 ppm would be quite satisfactory to maintain Tridacnids.

Compatibility

A discussion concerning the compatibility of Tridacnids with each other or any other reef animal is delightfully simple. Essentially, any tank big enough to house Tridacnids with anything that won’t eat them or overgrow them is a compatibility success! Unlike many other marine invertebrate groups, they exude no significant noxious compounds or chemically defensive elements. With enough space to grow and mature under an unobstructed view of appropriate light, Tridacnid clams will prosper. Beware, though, that some so-called “reef safe” creatures find such clams to be a delicacy. More than a few species of shrimp, crabs, and fishes may prey on clams but not necessarily corals. And once a clam is established in a safe residence, aquarists must of course be diligent in preventing sponge, coral, algae and other invertebrates from growing, overshadowing or stifling their passive Tridacnid clams. While Tridacnid clams seem to be somewhat indifferent to the sting of many reef corals and invertebrates, the simple



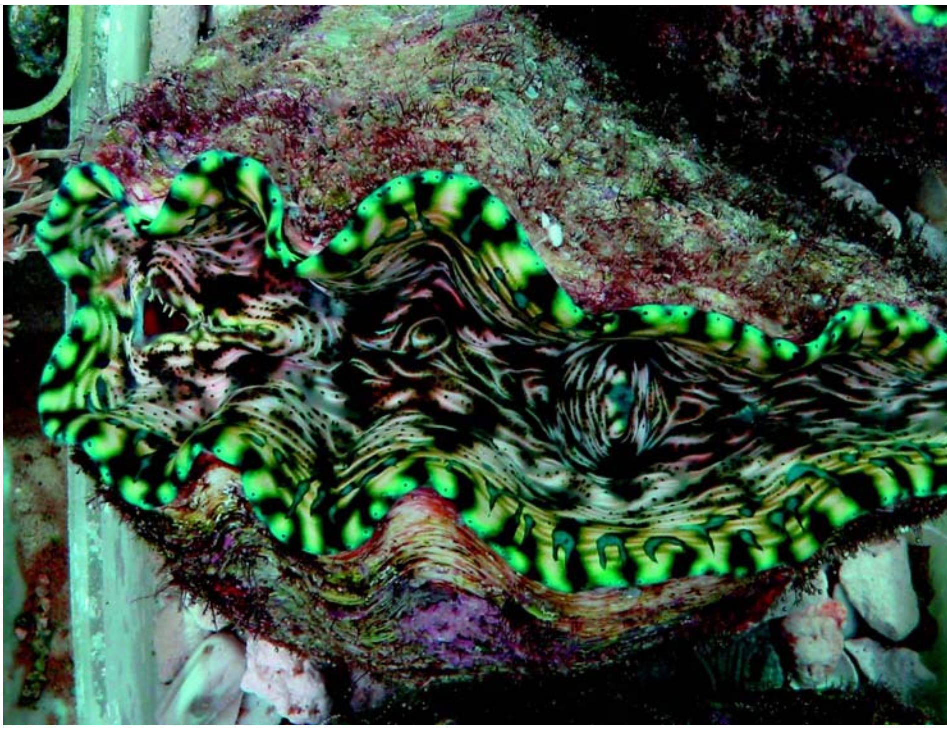
Mantis Shrimps Triggerfishes Cleaner Wrasses



Crabs Angelfishes Lysmata Shrimps

These reef creatures are somewhat to very likely to prey on Tridacnid clams.


H. hippopus (B. Neigut) T. squamosa - aquarium photo (B. Neigut)



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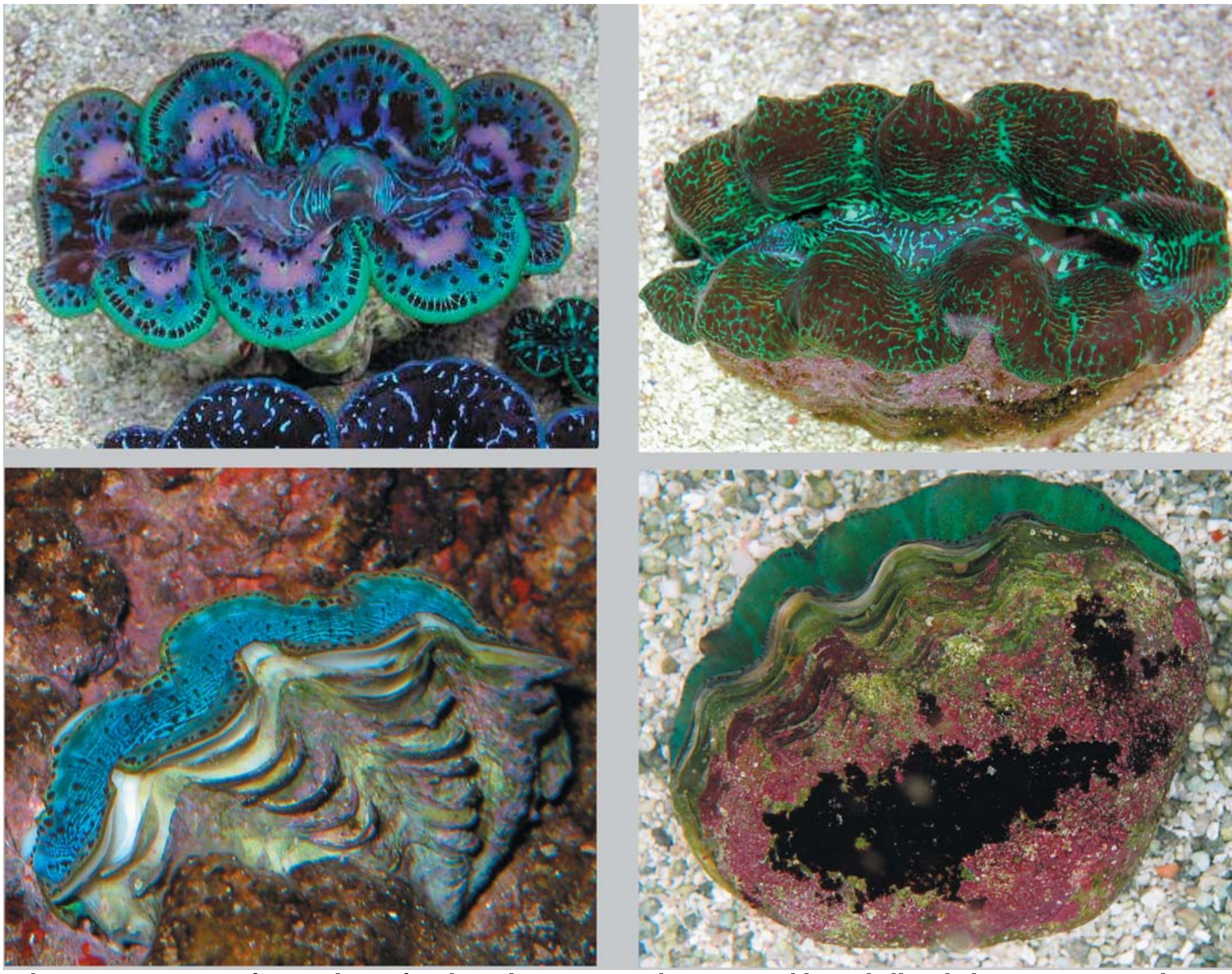
obstruction of light to the symbiotic clam by the overgrowth of a close neighbor can prove to be fatal. Aggression by cnidarian neighbors is surely inevitable with some species. As with coral, it is best to prevent stinging animals from growing upon or contacting Tridacnid species.

Special Notes

Categorically, the best clam species for display by casual aquarists are *Tridacna derasa, Tridacna squamosa* and *Hippopus hippopus.* These three Tridacnids are the hardiest members of their subfamily with all things considered. They ship well and acclimate to a wide range of light and water quality conditions. Aquarists commonly find that they are the least demanding Tridacnids with regards to light intensity and spectrum, and that they often fare better in aquariums that are overstocked, overfed and have a higher level of dissolved organics. Again, if any of the Tridacnids could fairly be called "starter" clams for beginners it would be *Tridacna*

Tridacna maxima Tridacna crocea



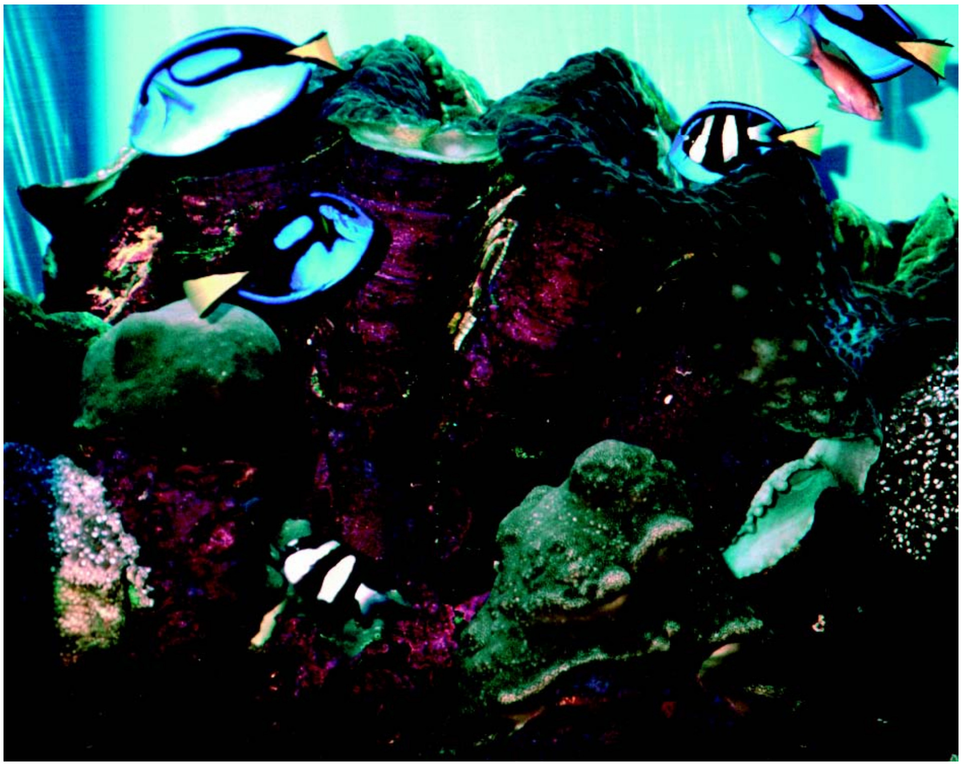
These two species are frequently confused. *Tridacna maxima* has a more oblong shell with deeper grooves and very pronounced scutes. (*Top row: B. Neigut, Bottom row: L. Gonzalez*)

derasa, Tridacna squamosa and *Hippopus hippopus.* The only significant consideration for keeping these three species is their adult size at over 18”. As with all reef creatures, long term planning for growth is quite sensible and necessary.

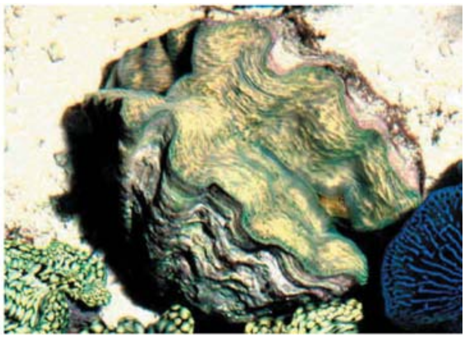
Tridacna crocea and *T. maxima* are indeed the most popular and sought after clams for their extraordinary mantle colors in combinations too numerous to mention. Alas, they are also more likely than most Tridacnids to suffer from shipping-induced duress. Furthermore, they can be quite sensitive to waning or inadequate light over aquaria. For these reasons and more, the crocea and maxima clams

T. maxima is commonly imported at 2-3” (5-7.5 cm) but is not the best “starter” clam for new aquarists due to its strict demands for light and other sensitivities. (L. Gonzalez) are not to be recommended to new aquarists and beginners.

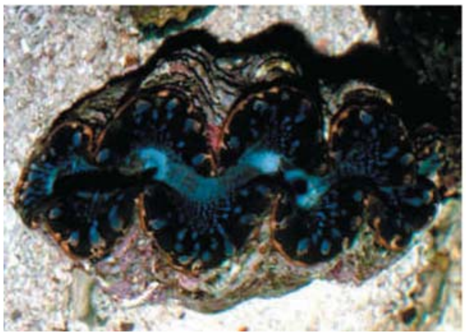
Tridacna gigas is somewhat of an uncommon import into America. The limited availability is just as well, since this true "Giant Clam" seems to suffer from handling and shipping trauma easily. It is also the fastest growing species (1/2" per month is easily possible). Few privately held aquariums can adequately house such a specimen in progress through adulthood to an extraordinarily large weight and length!

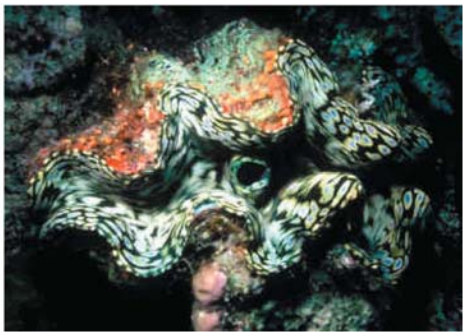


The huge Tridacna gigas at the Waikiki Aquarium, weighing several hundred pounds and captive grown for over ten years.



Tridacna crocea (L. Gonzalez) Tridacna maxima (L. Gonzalez) Hippopus hippopus





T. squamosa unusual blue, in captivity **Tridacna derasa** (L. Gonzalez) **Tridacna gigas** in Fiji

Right, Tridacna maxima. The Acropora coral seen here can quickly over-shadow and light-starve a clam if allowed to grow unchecked. (L. Gonzalez)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