

Invertebrates With Backbone

How they avoid being dinner.

By Nick Dakin

Did it ever occur to you that you might be witnessing the potential for a full-blown battleground in your own house? However unlikely it may seem, if you have an aquarium stocked with invertebrates, the chances are very good that some animals may be on the offensive already.

It is probably fair to say that a significant number of marine aquarists believe invertebrates to be almost totally benign and compatible under virtually all circumstances. Reef tanks are often fully stocked with little understanding of the possibilities for fierce interaction between the groups of animals.

In the aquarium, as in the wild, competition is every bit as intense among invertebrates as that witnessed in fish. It may often happen at a far slower rate and thus be less noticeable, but the need for territory and food is still a vital requirement for survival, and invertebrates will protect themselves and their livelihood by any means at their disposal.

Lifestyles

The majority of marine invertebrates begin their life cycle as a fertilized egg, which then hatches into a pelagic larva spending time in the plankton layers of the sea — to eat and be eaten. Those that survive and are suitably developed then begin the search for a permanent home.

For some, this may involve continuing to drift largely at the mercy of ocean currents, as is the case with jellyfish (a pelagic existence), or it could mean migrating down to encounter a hard substrate on which to become permanently attached, as corals and gorgonians do (a sessile existence). Alternatively, mobile invertebrates like shrimps, crabs and worms will take up residence on or under the substrate (a benthic existence).

Threats and Cooperation

Whatever their place in the scheme of an ecosystem, invertebrates face threats from all sides, and if any species is to be assured a permanent place on the planet, it is essential that it develops an effective means of protection. But just what are these threats?

By far the most serious single threat to all invertebrates is that of being eaten. Preservation of the species demands that a stable population survives, and this can be achieved only if a certain number of individuals can avoid being eaten by creatures higher up the food chain.

Other threats, no less important, include that of being made homeless. Without a home, the right to territory may simply disappear and leave the creature open to predation, starvation or being harried to death by other territory holders. Even those with established territories may come under constant attack from competitors.

It is often forgotten that invertebrates also come under pressure from those animals that regard the surface of another body as a potential home. Barnacles are an excellent example, and the reason why many sessile invertebrates have to regularly slough off a mucus membrane on which the larvae of such animals have settled. Failing to do so would mean being swamped and eventually overwhelmed to a point where normal existence would be impossible.

Having said that, some invertebrates actually invite other animals to take up residence upon them for mutual benefit. This particularly applies to anemone hermit crabs (e.g., *Dardanus pedunculatus*), which encourage certain species of anemone to live on their shell. The anemones are happy to oblige, for hermit crabs are very messy eaters and many scraps of food missed by the crab are collected by the anemone(s) as a welcome source of food. In return, the hermit crab gains the added protection of the anemone's stinging tentacles, discouraging their main predators, octopuses.

The boxing crab (*Lybia tessellata*), however, uses anemones in a far more active manner. Armed with an anemone on each claw, it waves these weapons at approaching predators as a warning! Again, the anemone collects the particles of food overlooked by the crab, and the crab is more effectively protected.

Usually though, truly symbiotic relationships of this nature are not very common in the invertebrate kingdom, although there are other examples of commensalism whereby crabs (e.g., *Neopetrolisthes* species) and shrimps (e.g., *Periclimenes*)

species) are known to reside within the protective tentacles of anemones. Just what the anemone gains from this sort of relationship is not always clear. Such shrimps and crabs are non-aggressive and unlikely to defend the anemone from predators. However, they have been known to clean the anemone host of parasites and share the occasional meal (albeit accidentally!). Otherwise, the anemone emerges from this sort of interaction unharmed, but not a great deal better off.

Being removed from the ocean and placed in an aquarium in no way discourages natural behavior, and enforced closer proximity than would normally be found in the wild can sometimes exacerbate a developing conflict. The means by which the majority of invertebrates protect themselves arguably fall into nine main categories, although individual families or species may share a variety of different combinations.

Teeth

The vast majority of invertebrates do not have teeth as such, not in the way fish or mammals do. But a number of species possess very good substitutes that are normally specific to feeding activities.

For example, the octopuses and squids both have a horny beak with which to bite into their prey and tear it apart, often injecting a paralyzing venom in the process. If attacked, the beak can also act as a very effective defensive weapon with which to deter potential predators.

Some segmented worms (annelids) possess strong jaws with piercing mouthparts also capable of injecting venom into hapless prey. However, unlike those of fish and mammals, invertebrate "teeth" are rarely designed or employed for defense, and nearly always remain purely functional feeding implements.

Spines

Anyone who has been pricked by a sea urchin will be able to give a good account of spines, for they are a very effective — not to mention painful — form of protection. Although sea urchins are the best example of spines on full exhibit — many being laced with venom, some mollusks also have a trick or two up their sleeves...quite literally!

The cone shell normally hides in the sand during the day with just a breathing syphon exposed. Should a suitable victim, or threatening predator, come within range, a hollow spine darts out from a sheath to inject the unlucky victim with a quick-acting and lethal venom. Marine animals (usually small fish) die almost immediately and come to rest close to the mollusk before other scavengers can take advantage of the kill. The poison is so potent that human fatalities have also been recorded, usually as a response by the cone shell to trampling feet.

Sooner or later most marine aquarists will encounter a bristleworm (*Hermodice carunculata*). They hide beneath rocks and sand during the day, ready to emerge at night to scavenge on detritus. Their bodies are covered with masses of fine, hollow-barbed hairs that give rise to the common name. In addition, the miniature spines may be accompanied by a mild venom. If touched, the hairs readily pierce delicate tissues like human skin and the flesh of fish. Humans may experience an irritating rash, but fish are often extremely distressed by the experience — particularly if the face and eyes are affected.

Stings

Jellyfish and anemones are quite rightly famous for their stinging capabilities, and many other cnidarians (sting-bearers) also possess a similar armory. In each case, a stinging cell known as a nematocyst can be triggered into firing by the touch of an alien body.

Each cell ejects a hollow thread, barbed like a harpoon, into the body of prey or an enemy, and injects a paralyzing poison. In an effort to maintain sufficient territory within which to grow, many hard corals use much elongated tentacles known as "sweeper" tentacles to sting their neighbours and stop them from encroaching on a previously claimed area.

Such activity is often seen in the aquarium, particularly if hard corals are positioned in close proximity. "Burn" marks may result as the dominant coral asserts itself. In extreme cases, the subordinate animal may be killed in a prolonged attack!

Claws

Claws are normally carried by crustaceans such as crabs, shrimps and lobsters. They are usually fully obvious to any potential attacker and often make a formidable defense. Equally, they can be used to pick up tiny morsels of food in a most delicate manner or tear off lumps of flesh from a substantially larger meal! Invertebrates with large and effective claws can often cause disruption within the aquarium by pursuing other animals and damaging sessile invertebrates, as well as disturbing rockwork and other decorations.

Camouflage

If an invertebrate can remain undetected by a potential predator even though in full view, then the defensive strategy is

almost complete — no valuable energy need be wasted fighting for survival. Many crabs, shrimps, lobsters and sea slugs possess superbly camouflaged bodies as they hide among coral rubble or algae.

Cuttlefish, squids and octopuses are also masters of disguise. Using pigment cells within the skin called chromatophores, they can blend in with their immediate surroundings should the need arise. Highly camouflaged invertebrates, such as the monkey shrimp (Saron species), are readily available to the marine aquarist, but prove not to be popular as they are dull and difficult to see.

Poisons

Have you ever wondered why many nudibranchs and flatworms are so highly colored? It is because their flesh is so extremely unpalatable to fish and other potential predators that they actually advertise the fact and make no effort to hide! Indeed, some species are so toxic they can prove fatal to a persistent hunter.

Sea cucumbers are similarly endowed with distasteful skin and viscera — some species eject the latter from their bodies as a diversionary tactic. Even the eggs of the popular sea apples can prove fatal if consumed by hungry fish, a very real problem, especially in the confines of the aquarium.

Polluting the water is a good defense strategy, and one adopted by octopuses, squids and cuttlefish. If they feel threatened, these cephalopods eject a sepia-colored fluid, commonly known as "ink," into the water. While not particularly toxic, it can confuse a pursuing predator long enough to allow an escape. Behavior of this sort in the wild is of minor concern because dilution of the ink is rapid and an insignificant threat to other wildlife. However, in the aquarium, inking can be stressful to the creature doing it, although rarely fatal. Fresh activated carbon can quickly adsorb the pollutants and prevent any threat to health.

Shells

External shells are an extremely effective form of protection. Acting much like a medieval suit of armor, they enable soft-bodied animals to venture out during the hours of daylight to search for food in relative, although not complete, safety.

Clams, conches, cowries, scallops, oysters, crustacea and nautilus all find shells an invaluable form of defense from harm, as well as a means of bodily support. Clams and other bivalve mollusks are particularly well-known for their ability to close their shells extremely tightly, making it almost impossible for predators to gain access to the flesh within.

Hermit crabs do not possess a shell of their own and must utilize an empty one that was once owned by another species of crustacean. That previous owner may have died, or, in some cases, been deliberately killed and eaten by the hermit crab, which then steals the shell! Without the protection of a shell, hermit crabs remain soft-bodied creatures that are almost totally defenseless.

In order to grow, all crustacea have to regularly shed their external skeleton (the exoskeleton) and are extremely vulnerable at this time until the new exoskeleton hardens. Their soft bodies make an enticing meal to many predators (sometimes even those of the same species) and cause the temporarily unprotected creature to seek refuge in a safe cave or crevice.

Aquarists must take care to not house fish or invertebrates that might take advantage of this transitory condition, or at least provide suitable hiding places for the unprotected animal to safely retire to.

Flight

Departing from the scene of potential conflict is a very acceptable and effective defense mechanism, and is practiced by a number of invertebrates. Scallops, many sea slugs, octopuses, squids, cuttlefish, nautilus, shrimps, crabs and lobsters are all capable of rapidly, avoiding any serious threat by flight. In the case of the cephalopods, an ink may also be produced in their wake to confuse a pursuer (see Poisons).

Tubes and Other Defenses

Fanworms can frequently avoid predation by swiftly retreating into their tubes, often sealing themselves in by means of a hatch-like cover. Cerianthus anemones construct a tube from small particles, thus creating a convenient hiding place from inquisitive fish. Equally, many species of polyp can quickly withdraw into a safe self-generated structure, if threatened. Clavularia, gorgonians and a range of hard corals all possess this ability.

While not strictly classed as a self-made construction, many invertebrates use a sandy substrate into which to withdraw. The sand anemone (*Heteractis aurora*) would make a fine meal for a multitude of fish were it not for the fact that at the first sign of threat, it disappears deep beneath the sand in a cloud of particles!

Observations Are Important

The interactions of invertebrates can be fascinating to study, and can also alert the marine aquarist to various problems that may arise. An invertebrate that has obviously had to invoke a defense mechanism is in conflict with another animal, and suitable remedial action should be taken once the two parties have been identified.

Human Safety

Various defense mechanisms can also pose a threat to the aquarist, who, for his or her own safety, should be aware of the dangers. Life-threatening invertebrates, such as the blue ring octopus (*Hapalochlaena maculosa*), cone shells (*Conus* species) and a few species of sea urchin (e.g., *Toxopneustes pileolus*), are rarely encountered in the aquatic trade, but they do turn up from time to time. Knowingly housing such dangerous creatures must be regarded as wholly inadvisable, if not downright irresponsible, unless the correct safety precautions are adopted.

Removing invertebrates that pose a threat to humans is not a task to be undertaken lightly. Plastic aquarium tongs should be used wherever possible, and should the creatures be disposed of in a responsible manner. For example, the cone shell venom can still remain dangerous even though the creature might be dead — throwing it out with the household waste is not recommended. Taking it to a pharmacy where it can be included in the hazardous waste is far more responsible.

Conclusion

Not all means of protection can be 100 percent effective, nor should they be. If they were, food chains could not operate properly and the world would eventually be knee-deep in those creatures that proved to be indestructible (as another predator, man, has already proven very well!).

Although we often pretend our reef aquariums are an accurate re-creation of the wild state, this can never be so. The complex interactions that take place on the wild coral reefs are impossible to duplicate in a small glass box containing an artificially chosen population.

In the aquarium, predators are often removed so that all creatures can exist side by side unmolested. As aquarists, this is one of our main aims — a peaceful tank in which no animal is under threat from any tankmate and where all can survive to achieve their full potential. Choosing invertebrates carefully for the aquarium environment is an art in itself, and one that all marine aquarists would do well to learn if the goal is a harmonious, as well as beautiful, display.