Clown Anemonefish (Amphiprion percula in a Gigantic Sea Anemone) (Stichodactyla gigantea)

Marine Symbiosis: Clownfish & Anemones

The mutual symbiosis between clownfish and their host sea anemones

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Clark's Anemonefish (Amphiprion clarkii) in a Bulb-tentacle Sea Anemone (Entacmaea quadricolor)

Symbiosis means living together. Symbiotic relationships exist on land as well as underwater, however in the densely packed environment of a coral reef, there is a concentration of symbiotic relationships far greater than in any other habitat. What makes marine symbiosis especially interesting is that many of these relationships are between animals one might normally expect to prey on one another. Symbiosis can be *"mutual"* wherein both partners benefit from the relationship. Alternatively it can be *"commensal,"* where one symbiont gains from the relationship, while the other is unaffected, neither benefiting nor being harmed. A third alternative is *"parasitic,"* in this case one symbiont benefits, but at the expense of the other.

A *mutual* relationship exists between Clownfish and Anemones and since clownfish are poor swimmers, they would be easy prey without the protection of the host anemones. There are 28 species of Clownfish found only in the Indo-Pacific and they are found living only with 10 species of Sea Anemones. Anemones are members of the Cnidaria family, which includes Hydroids and jellyfish: all of these animals are equipped with microscopic stinging structures called nematocysts located at the end of their tentacles. Nematocysts are strong enough to kill small fish so most stay away. Clownfish are unaffected and so can use the anemone as a shelter from predators. Paradoxically, the Clownfish aggressively protect the anemone from marauding Butterfly fish who would otherwise attack the anemone's tentacles notwithstanding the nematocysts.

Pink Anemonefish (Amphiprion perideraion) in a Magnificent Sea Anemone (Heteractis magnifica)

The symbiotic relationship between these animals has been studied since the middle of the nineteenth century, but there is still no certain understanding as to why the Clownfish is not stung by the Anemone. The most popular view is that the fish coats itself with mucus, which creates an insulating and protective layer.

An interest in Symbiosis occurred the same time that I saw my first Clownfish hiding in an Anemone. Everyone benefits by knowing more about symbiosis, because it helps us to understand further about the reef environment and the complex relationships amongst its inhabitants.

Many of the images were shot on Velvia film with a Nikonos RS, perhaps the last and greatest underwater film camera. Images made over the last five years have been shot digitally using a Nikon D100 mounted in a Light & Motion housing. While the old RS was commendable, the digital camera with its on-board histogram to check exposure, and the greater image capacity (more than 36!) of flash cards have made the digital system the much preferred alternative. All of the images were shot with strobe.

The anemones that host clownfish are quite interesting animals. The surfaces at the end of the tentacles contain nematocysts: fluid-filled cells each equipped with a harpoon-like structure which itself contains a toxin. The anemone uses the nematocysts to defend itself against predators (we're more familiar with the stinging cells in jellyfish, which are also nematocysts). While not as powerful as some nematocysts, those present in anemones are strong enough to kill small fish. Besides clownfish, anemones host another important symbiont; the single-celled algae Zooxanthellae. This algae has the ability to synthesize proteins from sunlight, so much more than it needs for its survival that it provides the excess to its host anemone, which is very significant to the survival and growth of the anemone. The critical importance of zooxanthellae to the anemone means that anemones are found

Spine-cheek Anemonefish (Premnas biaculeatus) in a Bulb-tentacle Sea Anemone (Entacmaea quadricolor)

Red & Black Anemonefish (Amphiprion melanopus) in a Bulb-tentacle Sea Anemone (Entacmaea quadricolor)

Clark's Anemonefish (Amphiprion clarkii) in a Delicate Sea Anemone (Heteractis malu)

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where they can benefit from sunlight, meaning approximately seventy feet below the sea surface. Clean water and moderate to strong currents are also important because they bring plankton to the anemone and the hosted clownfish.

The life cycle of anemonefish has been

Pink Anemonefish (Amphiprion perideraion) in a Magnificent Sea Anemone (Heteractis magnifica)

Red & Black Anemonefish (Amphiprion melanopus) in a Bulb-tentacle Sea Anemone (Entacmaea quadricolor)

extensively studied, no doubt because their symbiotic relationship with anemones meant they wandered little from the safety and shelter of those obligate hosts. Populations of anemonefish consist of a dominant female, which is usually the largest fish present in that anemone. The next largest is the dominant male, often less than half the size of its partner. The remaining anemonefish are juvenile males. Spawning takes place monthly apparently following a lunar cycle. The female lays the eggs on the underside of the anemone's mantle where they are first fertilized and later guarded by the male. The fish frequently groom the eggs by fanning the nest with their pectoral fins. The eggs hatch in about a week and the larvae soon are dispersed over the reef. When the dominant female dies, the dominant male experiences a sex reversal and becomes the new dominant female. Simultaneously the largest non-breeding fish becomes the dominant male. The behavior is "efficient" since otherwise the "family" would have to wait for the arrival of another fish of the appropriate sex!

The images that appear in this article were made over a period of several years and in a number of locations. Indonesia is one primary location; specifically the chain of islands that stretch east of the small island of Bali, all the way west to New Guinea. These islands are known as Nusa Tenggara, which roughly translates into "eastern islands." The other prime location has been Papua New Guinea, both the southeastern coastal region of Milne Bay and off of the north shore of the island of New Britain.

Spine-cheek Anemonefish (Premnas biaculeatus) in a Bulb-tentacle Sea Anemone (Entacmaea quadricolor)

Pink Anemonefish (Amphiprion perideraion) in a Gigantic Sea Anemone (Stichodactyla gigantea)

Orange Anemonefish (Amphiprion sandaracinos) in a Merten's Sea Anemone (Stichodactyla mertensii)