Nature's Plankton Net: Sea Fans of the Pacific

JUST OFF KARUMOLUN POINT on one of the smaller Solomon Islands, the constant turmoil of the sea has carved a tunnel through a steep limestone wall. The tunnel, five meters long and two and a half meters wide, is easily large enough to tempt a passing diver to explore its eroded walls. Yet, anyone who wanders in is halted half-way through. There a large, intricate net blocks the passage of any creature larger than a diver's little finger. Since the local people are excellent fishermen, this discovery would not be particularly noteworthy if it weren't for one remarkable fact. As immobile as it seems, this net is alive. It is the body of a single sea fan belonging to a common western Pacific species called *Subergorgia mollis*.

Despite sea fans' fragile appearance, their finely branching bodies sway in the rushing current like colorful flags. They vary in size from three meters to less than a tenth of a meter, and come in striking reds, yellows, pinks, and purples reminiscent of Pacific Island sunsets.

Though they look like small trees, sea fans are animals. A kind of coral, sea fans are most closely related to the colorful blooms of soft corals as well as the sea pens. While sea fans are often found near or on coral reefs, they do not build reefs like their hard coral relatives. Sea fans, and all corals, have hard skeletons, made of calcium carbonate or a tough fibrous horn-like protein, or a combination of the two.

There are a thousand or more different kinds of sea fans, all possessing minute skeletal particles of calcium carbonate known as spicules (or sclerites). The numerous spicules in the tissues of a sea fan help give it physical support and make it unpalatable to most predators. Spicules also help scientists to distinguish between different species of sea fans. They represent the "fingerprint" of a particular species.

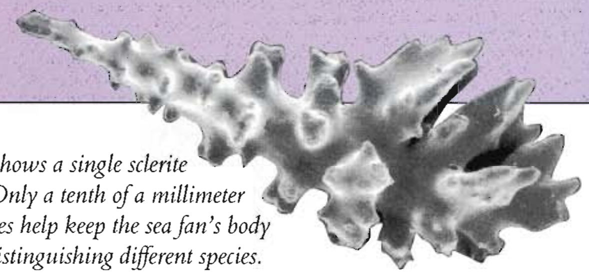
Scientists consider sea fans, and their coral relatives, to be part of the coelenterate or cnidarian phylum. Coelenterates, a group which also includes jellyfish, sea anemones, and hydroids, are unique among animals in their relatively simple body plan. Unlike our own bodies' bilateral plan, cnidarians are built with radial symmetry, where similar parts radiate outward from a central point as in the spokes of a bicycle wheel. Their bodies are made of only two tissue layers, as opposed to the three tissue layers of more complex animals. The body of each polyp has a sac-like digestive cavity with only one opening (for both feeding and excreting). They also have specialized stinging cells called nematocysts.

Little is known about reproduction in most sea fans. Polyps release egg and sperm into the current. Fertilized eggs develop into a larval stage, known as a planula, which settles on a suitable surface. The now sedentary planula becomes a founder polyp which gradually grows into a new sea fan.

Hard and soft corals typically dominate the shallow reefs of the Indo-Pacific region where sea fans thrive. Here, competition for light is keen since many corals harbor symbiotic algae that need the light for photosynthesis. Corals, like sea fans, which are not so light-dependent, find their niches in sandy gullies, potholes, and the deeper regions of the reef.

Like a delicate gate opening to the ocean, the sea fan Subergorgia mollis *graces a Solomon Islands reef. The brilliant scarlet color comes from a thin coating of algae. Usually this species is creamy or pale orange.*

Article and Photographs by GARY C. WILLIAMS



This scanning electron micrograph shows a single sclerite from the sea fan Acabaria rubra. *Only a tenth of a millimeter long, these calcium carbonate particles help keep the sea fan's body rigid. They also assist scientists in distinguishing different species.*

Alcoves, overhangs, and vertical surfaces provide ideal habitats for some species of sea fans. And, while most sea fans live in tropical reefs, they are found throughout the world's oceans, including polar seas, from the low intertidal zone to near the bottom of the deepest trenches. Several species of shallow-water sea fans are found off the southern California coast.

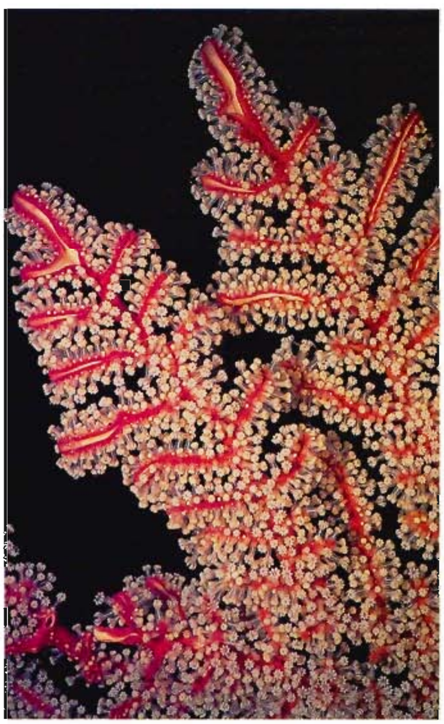
During development, sea fans grow perpendicular to strong, prevailing ocean currents and wait for the sea water to deliver planktonic banquets. A close look at these sedentary plankton nets reveals thousands of tiny individuals, called polyps, covering their branches. When a sea fan feeds, the polyps open and they appear to bloom like a flowering tree in the spring. From each polyp eight feathery tentacles burst forth. Together, the sea fan's branches, polyps, and tentacles create a trap that captures small particles that come by, borne on the current.

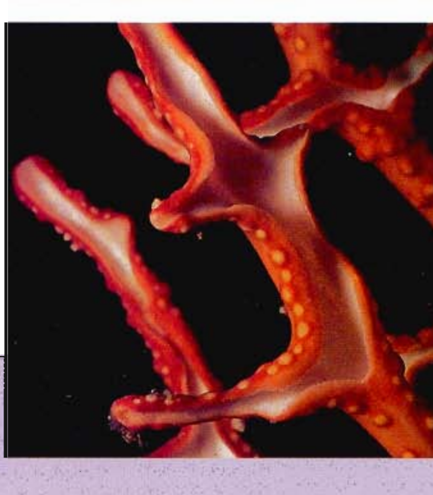
Academy scientist Robert Van Syoc and I have been investigating the ecological relationships between sea fans and barnacles. We have found that the interactions are surprisingly common. Coastal currents contain numerous barnacle larvae searching for a steady place to attach. When barnacle meets sea fan, a slow-motion battle between two sedentary creatures ensues. While healthy parts of the sea fan are protected by nematocysts, injured tissues and exposed areas on the sea fan's axis provide a suitable surface for some kinds of barnacle larvae to settle.

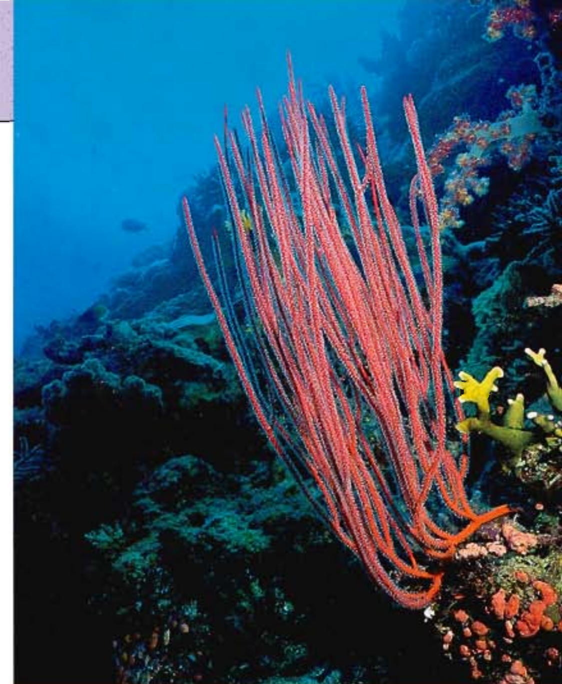
Sea fans respond by trying to repair the damage, overgrowing the developing barnacle with new spicule-rich tissue that forms a conspicuous protuberance. Frequently, the barnacle hangs on and is able to keep a space in the sea fans' tissue open for feeding. Sometimes, the sea fan is the victor, and the barnacle becomes encased in the sea fan's tissue and dies.

We are continuing to investigate whether the barnacle-sea fan relationship is specific to certain species and whether two species have evolved interdependently while sharing an obvious ecological interaction. "Apparently, a particular barnacle needs to find a particular species of sea fan to survive....It seems likely that certain barnacles are found only on certain sea fans," says Van Syoc. The next research goal is to investigate the evolutionary relationships of the two groups to see if indeed the evolution of one has influenced the other. □

GARY C. WILLIAMS *is Chairman of the Academy's Department of Invertebrate Zoology and Geology. He is co-author with Terry Gosliner and Dave Behrens of a new book,* Coral Reef Animals of the Indo-Pacific, *due for publication by Sea Challengers this summer.*







Left: Though they resemble trees, sea fans are animals. They feed by extending flower-like white polyps from branches that jut into ocean currents. Each polyp sports tiny tentacles that trap plankton drifting by in the current. A close-up view (bottom left) of one branch in the sea fan Semperina *sp. shows the rounded knobs into which polyps retract in self defense or in bright light. Polyps tend to come out at night, when plankton rises through the water to shallower depths.*
Top: In the case of Ctenocella *sp., a common sea fan in the Philippines, the red color is permanent and comes from a pigment inside the spicules.*
Above: Close relatives of sea fans, soft corals belong to the phylum Cnidaria along with jellyfish, sea anemones, and other invertebrates. All share a body plan that is radially symmetrical, as can be seen in this polyp of the octocoral Clavularia *sp. Eight feather-like tentacles radiate from the central mouth; an identical pattern occurs in the much smaller polyps of sea fans.*