Mangrove Cay Sponge Havens of Belize

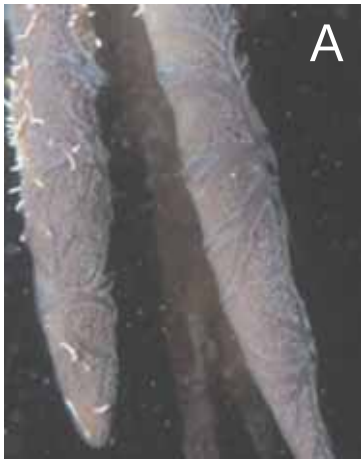
Photograph by Chip Clark

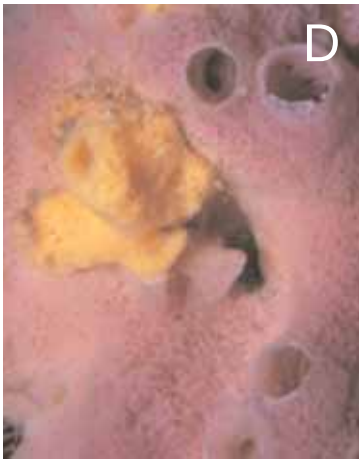
Viewed from an airplane, the mangrove cays of the Belize Barrier Reef are uniformly green islands in the variously blue sea. On some cays the trees may be short or tall, but the canopies always appear dense and the trunks well stabilized in the shallow mud by their arched prop roots. Approaching the mangroves in a boat, the water right around them is not obviously inviting, as the closepacked trees cast deep shadows and raise disconcerting thoughts of crocodiles in the murk. But if you get close enough to gaze straight down into the water, following prop roots with your eyes as they descend beneath the surface, an astonishing array of colours and shapes tempts closer exploration.

Underwater the roots are festooned, often to a thickness many times their diameter, with sponges, the most ancient of multicellular animals. At first it may not be clear that the intensely colourful and asymmetric lumps, tubes, runners, and mats covering the roots are animals, or even alive. Each sponge individual is a simple mass of cells, given form by a skeletal framework made of protein fibres that in most species – but not those that we use as bath sponges - are reinforced by tiny silica spicules. Sponges feed on bacteria and other small organic particles that their cells filter out of the water as it flows through a complex system of canals permeating their bodies. They have no stomach, nervous system, circulatory system, heart, or brain; so it is mysterious how the cells within a sponge coordinate themselves to build the skeleton, organize the canal system to pump water efficiently, repair wounds, grow in favourable directions, and mediate interactions with the thousands of other animals, plants, and microbes they may encounter.

Each of the more than 100 sponge species living on mangrove prop roots in Belize can be distinguished from the others by its typical shape and colour. A single metre long prop root might sport the enormous rounded mass of a saturated orange sponge, several smaller volcano-shaped pale yellow sponges, a fist-sized rosy purple sponge, a cluster of purple tubes extending as much as 30 cm into the water, a couple of large black ball-shaped sponges, their surfaces dotted with small bright turquoise sponges, with a whispy-surfaced sponge covered with bright red specks encrusting the remainder of the root surface. The assortments of sponges evoke artful arrangements of flowers, in which complementary sizes, shapes and colors have been carefully balanced. While no Ikebana master purposefully plans the sponge arrangements, the different sponge shapes functionally complement each other by representing different strategies for gaining and holding attachment space in this crowded community.

The only mobile stage in a sponge life cycle is the earliest, just as for plants. For sponges, joining of egg and sperm results in small rounded balls of cells called larvae, which swim for only a few hours before finding a spot on which to settle and, if all goes well, grow large and old enough to produce larvae of their own. Thus the assortment of sponges on any particular root depends on the chance settlement of larvae and the results of their interactions with other inhabitants of the root as they grow. Just as freshly ploughed gardens are colonized by seeds of weedy plants that grow quickly and then vanish quickly, bare spots on roots are quickly colonized by sponge species that grow and reproduce





A. Tips of mangrove roots that have recently grown below the water surface are colonized and quickly covered by this thinly encrusting species. The white star pattern on the surface reveals the canal system that carries food-bearing water through the sponge. The sponges are not harmed by the white tubes of small worms embedded in their tissue.

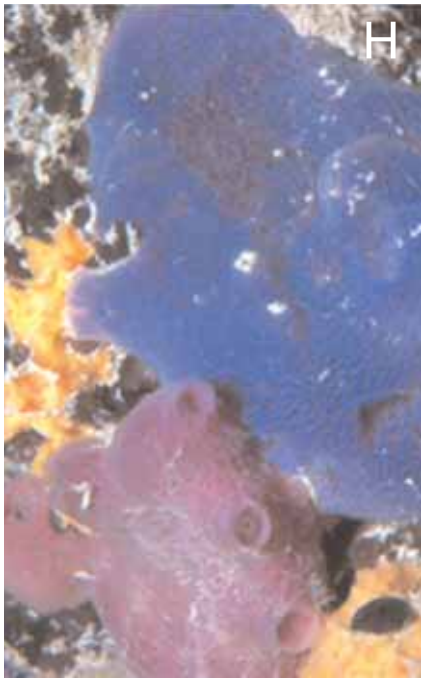
B. Efficient colonizers of bare patches, creamy yellow *Biemna caribea* and dusky purple *Haliclona cuaçaoensis*, grow quickly but are eliminated by subsequent colonizers.

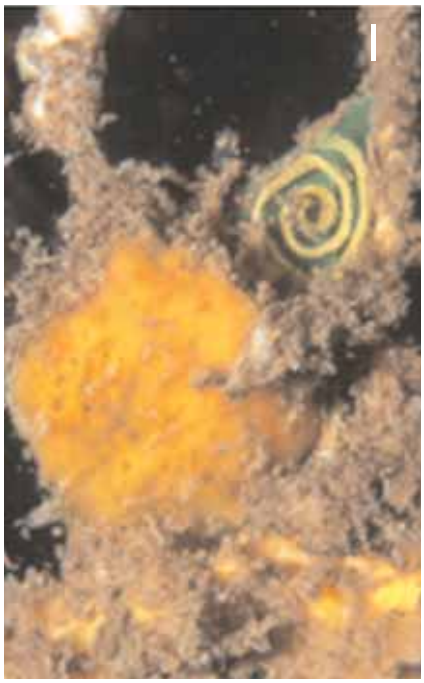
C. Relatively slowly colonizing species, the turquoise tube *Lissodendoryx isodictyalis* and purple cushion *Haliclona implexiformis*, begin to crowd earlier colonizers like the yellow *Biemna caribea* as they grow and require more root surface.

D. The last bits of what had been a large *Biemna caribea* are being squeezed off the root by the purple cushion of *Haliclona implexiformis*.

E. The purple *Haliclona implexiformis*, in turn, is here being overgrown by the "fire sponge" *Tedania ignis*. Two brittle stars, their bodies nestled in depressions between the sponges, spread their arms over the sponge surfaces. They are simultaneously collecting organic-rich detritus on which they feed and helping to keep the sponge water intake pores from being clogged.

F. The "fire sponge' *Tedania ignis*, one of the superior competitors in this community, is here forcing the turquoise tube sponge *Lissodendoryx isodictyalis* to relinquish its grip on the root by overgrowing its base.





quickly, but never get large or survive long. These species are eliminated by species that take longer to colonize but are better at overgrowing neighbours and usurping their space. One species compensates for being the preferred prey of a small sea slug by growing especially fast. Some sponge species grow and survive best when they live on the surface of other sponges, and other species have solved the need for space by figuring out how to thrive while they are almost entirely overgrown. Individuals of species that grow as clusters of long tubes minimize space battles by being able to achieve large size while gripping only a small patch of root surface. A sponge species that is one of the superior competitors is in turn vulnerable to being overgrown by a colonial sea squirt that looks like a harmless gelatinous layer but which eliminates the sponge by smothering it. Skeletons of dead sponges deteriorate and vanish in a few days, freeing up space to be colonized anew by larvae that are searching for a place to settle.

Sponges growing on the mangrove roots benefit their hosts by serving as an inpenetrable barrier to small crustaceans that otherwise damage the roots when they bore dwelling holes in them. Oysters, tube worms, and barnacles nestle among the sponges, filtering and consuming larger particles from the water. Decorator crabs carve off small bits of sponges and attach them to tiny hooks on their backs, where they grow and serve to disguise their jointed-legged hosts. Brittle stars sprawl their five spined arms over sponges as they collect and consume detritus that might otherwise clog the water-intake pores on the sponge surfaces, and seahorses gracefully rove among the sponges, pretending that they are one of them.

Clear open water, continuous expanses of solid substratum, and uninhibited access to sunlight might persuade human divers that coral reefs are an obviously superior habitat to the murky mangroves. For a sponge, however, clear open water is inhabited at a price. The clearer the water, the less food in it for bacteria-filtering sponges; and open spaces are vulnerable to storm waves. Channels through the mangroves of the Belize cays provide safe havens, protected from physical disturbances and full of food, for a rich profusion of sponges and their fellow inhabitants.

Janie Wulff
E-mail: *wulff@bio.fsu.edu*

Photographs by Janie Wulff

Also Published in *JMBA*
Wulff, J.L. Disease prevalence and population density over time in three common Caribbean coral reef sponges. *JMBA*, **87**.

G. The protein fibers of the sponge skeletal framework can be easily seen in the surface of the sky blue sponge *Dysidea etheria*, which is beginning to be overgrown by the purple cushion *Haliclona implexiformis*.
H. The black ball-shaped sponge *Spongia tubulifera* can barely be seen in this photo because it is covered by small turquoise blobs, *Haliclona manglaris*, soft orange with white tracery *Scopalina ruetzleri*, purple cushion *Haliclona implexiformis*, and deep blue volcano, *Lissodendoryx* sp. The *Spongia* continues to thrive even though it is nearly covered by the other species.
I. A yellow coil of fertilized eggs is a clear sign that this root is inhabited by at least one pair of small cryptically colored sea slugs that are capable of entirely eliminating large individuals of one of the fastest growing sponge species by steadily consuming them, preferring them over all other prey species.
J. A small piece of the crimson coral reef sponge species *Amphimedon compressa* was transplanted onto a mangrove root, where it has grown at a rate more than twice as fast as it grows in its home environment.
K. Small yellow seahorses are so cryptic in this complex community of multicolored sponges that they can only be distinguised by careful observation when they move.
L. A decorator crab has attached a piece of blue *Lissodendoryx isodictyalis* to tiny hooks on its back, causing it to look like another sponge, until it extends its legs to move.