# Redwoods of the reef

In the following discussion, **Professor Joseph Pawlik** explains his fascination with Caribbean sponges including the 200+ year-old Giant Barrel Sponge, and how their increasing prevalence may actually be due to human intervention, to the detriment of other animals and plants



**What inspired your research?**

I became interested in the ecology of sponges as an undergraduate student at the Marine Laboratory in Bermuda (now the Bermuda Institute for Ocean Sciences). I was intrigued by the diversity of colour and form of sponges, along with their distribution across all marine habitats in tropical Atlantic waters. I returned to working on them as a young Assistant Professor interested in chemical ecology because of their tractability as a model system, and also because they produce in their tissues the greatest diversity of unusual organic compounds of any group of animals.

**Why are sponges on Caribbean coral reefs of particular interest?**

Unlike coral reefs anywhere else in the world, those in the Caribbean are remarkable because species diversity is relatively low, and the same species are found throughout the entire biogeographic region. Sponges are also interesting because we know so little about them: How old are they? How fast do they grow? Are their populations increasing on reefs? – these are all questions we are seeking to address.

**What are your key findings to date?**

We have been monitoring populations of the Giant Barrel Sponge at two reef sites off the coast of Key Largo, Florida, since 1997. By photographing the same sponges through time, we have modelled their growth rate, and determined that the largest sponges – about the size of an oil drum – are about 200 years old; hence, the moniker 'Redwoods of the reef', is particularly apt. We have also discovered that populations of this species are on the rise, with a 46 percentage increase between 2000-06. In the 1990s, we determined that some of the different sponge species that live on the reef are protected from sponge-eating fishes by potent chemical defences, while other, equally common species appear to be grazed by fishes on a regular basis, much like cows eating grass in a pasture. Since then, we have determined that sponge species in these two categories divert their energetic resources differently: the former to the synthesis of chemical defences; the latter to rapid growth and reproduction.

**Your research suggests changes in the abundances of fish and sponge-eating fishes on Caribbean reefs. What impact do you think this will have on the sponge population and the broader community of corals and seaweeds?**

Most of the coral reefs in the Caribbean have been affected by fishing, but to very different degrees. Large, predatory fishes, such as sharks and groupers, have been removed from all but a few remote locations. Many reefs have been completely stripped of fishes larger than hand-size by fish-trapping. Others have been more selectively fished, through the use of lines, spears or nets. The result is that our conceptual model has been manipulated in different ways on different reefs. The removal of grazing fishes, such as tangs and parrotfishes, combined with the catastrophic loss of the black long-spinned sea urchin in the early 1980s, has resulted in high coverage by macroalgae on most reefs. But the more subtle effect has been to shift the sponge community toward undefended sponges, which are better able to out-compete other sponges and reef-building corals for space.

**What impact do you think factors such as global warming and overfishing will have on sponges in the future?**

Climate change and ocean acidification are likely to have less of an effect on sponges, which do not incorporate limestone into their skeletons (when present, their skeleton is made of glass), than on many macroalgae and reef-building corals, which do produce limestone skeletons. It seems likely that the combined effects of overfishing and ocean acidification will cause sponge populations to continue growing, perhaps to the detriment of other benthic animals and plants.

**How would you like to see your research develop in the future? Are there any further aspects of the chemical ecology of sponges that you would want to explore in more depth?**

As with most research projects, the answers raise more questions, and there are many angles to explore in the future, such as: how do sponges compete with macroalgae for space?; are there sponges that dominate macroalgae, and are they also chemically defended against predators?; what impact will the return of the black long-spined sea urchin to Caribbean reefs have on sponge communities?