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Editor's Corner

This issue of Seascope is dedicated almost exclusively to an article by Martin Moe, Jr. on a fantastic project that he and Ken Nedimyer conceived and implemented regarding the reintroduction of the sea urchin *Diadema* to reefs off the coast of Florida. Martin needs no introduction to readers of Seascope and I won't ruin the punch line here but, as with all of Martin's writings, this article is important, educational and shows what two concerned individuals can do! Congratulations are due to Martin and Ken for a fine project that yielded important results.

Still on my soapbox: pH

One part of water quality that I have constantly talked about is pH. pH has to be the most misused term in the fishkeeping hobby. It is difficult to discuss many important processes in aquaria without a correct understanding of pH. pH plays an important role in subjects such as ammonia and nitrite toxicity, calcium carbonate and carbon dioxide chemistry, alkalinity and many others.

In most articles, pH is usually defined as the measure of acidity or alkalinity of a liquid. This definition is not correct. Simply put, pH is a measure of the hydrogen ion concentration in a liquid. Technically, pH measures the molar concentration of the hydrogen ion (the weight of one mole, abbreviated "mol", is equal to the molecular weight of a material in grams). For our purposes a good working definition of pH is the hydrogen ion intensity or activity in a liquid. The "p" stands for power while the "H" stands for Hydrogen ion (always capitalized because it is a chemical element), together they mean the power of the hydrogen ion. The concentration of the hydrogen ion is measured on a logarithmic scale which ranges from 0.1 to 0.00000000000001 mol/Liter (L). These numbers can be rewritten as 10^{-1} to 10^{-14} mol/L. To make it easier to read, the mathematical definition of pH was written as the negative logarithm of the hydrogen ion concentration which converts the above numbers to the familiar pH scale of 0 to 14. For example, if the pH is 4, then there are 10^{-4} or 0.0001 moles per liter of hydrogen ions in the solution.

Since higher levels of hydrogen ion activity mean an increased acidic level, it should also be apparent from the above discussion why a 'lower' pH is more acidic than a 'higher' pH. A solution

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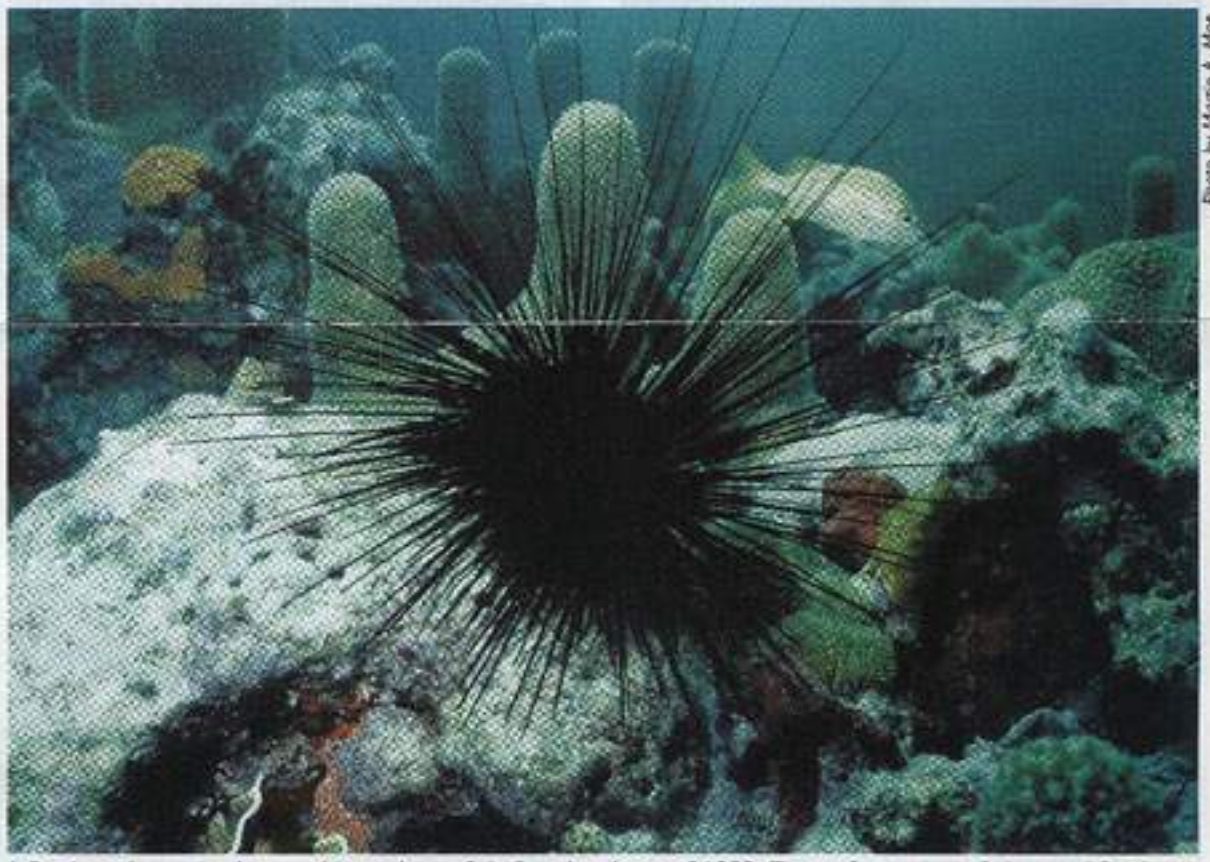

Photo by Martin A. Moe

A Diadema long-spined sea urchin on the reefs before the plague of 1983. The reefs are clear of algae and Diadema are everywhere.

Coral Reef Restoration:

Returning the caretakers to the reef

Martin A. Moe, Jr.

Despite the growth of civilization and the impacts of developing human populations, the reefs of the Florida Keys and the Caribbean thrived for hundreds of years while human populations exploded on the coastlines and islands, but then, suddenly, something changed. Within the geological blink of an eye, about 20 years, these reefs, those near human populations and those far from human impact, have precipitously declined. Coral cover on the Florida reef track has declined from about 70 percent in the 1960s and 70s to less than 10 percent today. Coral reefs throughout the world are in decline and none more so than the reefs of the tropical western Atlantic.

So what happened? Well, there are many factors implicated in the decline of tropical western Atlantic reefs. Broadly, these factors are increased nutrients, sedimentation, and turbidity from coastal development; direct impact from human visitation, over fishing, and destructive fishing methods; great ecological changes in reef organism diversity stemming from human exploitation and disease; and global warming (probably also anthropogenic) that raises surface seawater temperatures. This warm water so stresses corals that they release their symbiotic zooxanthellae algae (termed bleaching), weaken, and then die if the warming is severe and prolonged. The relative importance of these various factors vary with the location of the reefs.

There is one factor, however, that was constant. Through the millennia, the long-spined sea urchin, *Diadema antillarum*, were the keystone herbivores that grazed the reefs and maintained the balance between coral and algae growth that allowed the corals to flourish and build the vast calcium carbonate structures of the reef. There were immense populations of long-spined *Diadema* urchins on these reefs. Throughout this vast region the long-spined urchins were present in numbers of 2 to 20 urchins per square meter on the reefs and in the Florida Keys, 4 to 6 *Diadema* per square meter could easily be found on most reef formations. Small patch reefs could be easily identified from the surface by a mysterious white ring of exposed sediments that surrounded them. Research showed that these rings of exposed coal sand were caused by *Diadema* urchins moving off the reefs at night and feeding the surrounding

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