

Annals and Magazine of Natural History entitled "On manufactured Sea-water for the Aquarium". Again, that's in July of 1854! His reasons for developing a manufactured or synthetic sea salt are as valid today as they were then. As he wrote, "...the inconvenience, delay, and expense attendant upon the procuring of sea-water, from the coast or from the ocean, I had long ago felt to be a great difficulty in the way of a general adoption of the Marine Aquarium."

His formula contained only four chemical compounds (common table salt, Epsom salts, magnesium chloride, and potassium chloride), and it lacked buffering agents such as bicarbonate and chemicals such as calcium and strontium, necessary for reef-building organisms.

Throughout much of the 20th century, most SSS formulations were held to be inadequate for marine aquaria. Public aquaria such as the Shedd Aquarium in Chicago, Ill. had special rail cars constructed which hauled NSW from the Gulf Coast to Chicago, or the Aquarium would send seawater north to Chicago by barge up the Mississippi (Taylor 1993).

c. Augmented Seawater.

Augmented seawater is a liquid seawater product in which a manufacturer has added to natural seawater a number of chemicals or bacteria. Many claims are made for the benefits of these products, but no research has substantiated the claims.

Some sea salt manufacturers claim to add millions of bacterial cells to their mixtures. Doing so presents potential problems for the end user, however, since most bacteria are not desirable in seawater. For instance, heterotrophic bacteria can grow very fast, and that could cloud the aquarium water. Furthermore, these bacteria consume oxygen, leading to anaerobic conditions, which may kill the organisms in the aquarium. Likewise, other bacteria may produce hydrogen sulfide—a gas, with the smell of rotten eggs, that can also

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kill aquatic organisms. In summary, adding bacteria to a seawater mixture does not seem a viable option. It may be more marketing than science.

d. "Natural" sea salt.

Some manufacturers of sea salts claim that their salt is "natural" because their product is made with sea salt harvested from evaporative ponds next to the sea. Others just state "Natural" on their packaging without further explanation. Claims such as these are also little more than marketing, for several reasons.

The salt produced by solar evaporation in evaporative ponds (also known as solar ponds) is composed of sodium chloride alone. In fact, the goal of many salt plants is to produce as pure a sodium chloride as possible. Much research has gone into the sequence of events that occurs as seawater "evaporates." Of course, seawater doesn't evaporate; only water does, leaving behind the chemicals. It turns out that chemicals precipitate from seawater

in a specific order. The first chemicals to precipitate are the carbonates, such as calcium carbonate and magnesium carbonate. Next to precipitate, when about 32 percent of the original water content remains, is most of the gypsum (calcium sulfate) in the seawater. When the remaining water percentage is near 12 percent, more gypsum precipitates, along with sodium chloride. Eventually, 99.5 percent of the water evaporates, leaving behind just sodium chloride, some organics and a little water.

From the preceding brief description of solar evaporation, it is clear that "natural sea salt" produced by this method cannot be used directly in a marine aquarium. Since different chemicals evaporate at different points in the evaporative process, a single "salt" that mimics seawater does not result. Companies that use evaporative salt must, therefore, add back other chemicals to make a complete formula. Of course, such a formula is not natural!

PUBLICATION INFORMATION

SeaScope® was created to present short, informative articles of interest to marine aquarists. Topics may include water chemistry, nutrition, mariculture, system design, ecology, behavior, and fish health. Article contributions are welcomed. They should deal with pertinent topics and are subject to editorial reviews that in our opinion are necessary. Payments will be made at existing rates and will cover all author's rights to the material submitted.

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Advancing the Hobby of the Marine Aquarist

The International Year of the Reef

by Francis Staub, ICRI secretariat, IYOR coordinator, courtesy of AJH Environmental Services

Ask anyone to imagine a pristine ocean experience, and odds are they'll picture a coral reef, turtles and turquoise blue water. Sadly, coral reefs around the globe are succumbing to human abuse, and some predictions are that the reefs eventually will disappear, leaving only memories and photographs. Coral reefs support an extraordinary biodiversity, providing spawning, nursery, refuge and feeding areas for a large variety of organisms. Reef structures play an important role in protecting coastlines, by minimizing wave impacts from storms. Their beauties make them a powerful attraction for surfing, diving and other coastal tourism, generating income and employment for millions of people around the world—even in remote areas of developing countries.

Several attempts have been made to estimate the value of coral reefs in terms of dollars. Benefits from coral reefs can be categorized into two types: direct use values (fisheries and tourism industry) and indirect use values (benefits derived from coastline protection). According to a United Nations estimate, the total economic value of coral reefs ranges from US\$100,000 to US\$600,000 per square kilometer per year (Source: United Nations Environment Programme World Conservation Monitoring Centre, 2006).

Unfortunately, the latest reports of the Global Coral Reef Monitoring Network state that 20 percent of the world's coral reefs are in essence dead—damaged beyond repair. Another 24 percent of the remaining reefs are critically threatened—having a very high threat of destruction. Only 50 percent at present are classified as low risk. The majority of reef damage is not deliberate. Coral reefs are being degraded by an accumulation of stresses arising from human activities (over-fishing, pollution and coastal development top the list of chronic stressors) and from long-term climate changes that are affecting the world's oceans.



Colorful corals on the reef surrounding the vegetated sand cay, North West Island.

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SPECIAL EVENTS

- **MACNA XX**
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Westin Peachtree Plaza
Atlanta, GA
www.macnaxx.com
- **SuperZoo 2008**
The National Show
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www.Superzoo.org
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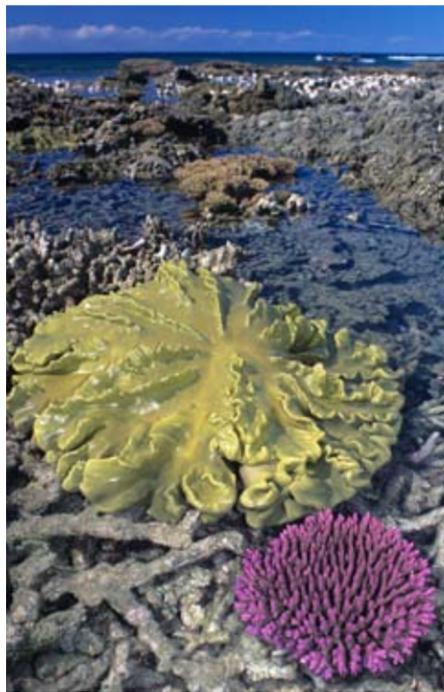


Bringing the
ocean home.

The lack of understanding about coral reefs, how they function, their value to humans, and their vulnerability to the impacts of human activity is a major threat to these ecosystems. Education at every level—from international to national, from young children to university students—is critical for changing behaviors and protecting coral reefs.

To raise awareness about the plight of coral reefs, the International Coral Reef Initiative (ICRI) has designated 2008 the International Year of the Reef (IYOR 2008). ICRI is a unique public-private partnership that brings together governments, international organizations, scientific entities and non-governmental organizations committed to reversing the global degradation of coral reefs and related ecosystems (such as mangrove forests and seagrass meadows) by promoting the conservation and sustainable use of these resources for future generations. The ICRI approach is to provide a platform for sharing information and to mobilize governments and a wide range of other stakeholders in an effort to improve management practices, increase capacity and political support, and share information on the health of these fragile ecosystems. In particular, ICRI aims to catalyze action that will (1) improve management practices, (2) increase capacity and political support, and (3) share information on the health of these ecosystems. The governments of the United States and Mexico are currently hosting the ICRI secretariat.

IYOR 2008 is designed to communicate effectively, to a variety of target



A Soft coral, Lobophyton sp., sometimes called Leather coral, and a small pink Acropora coral, on reef flats at Low Island.

audiences, the value and importance of the world's coral reefs and the threats to the reefs' sustainability. Its purpose is to motivate those audiences to take action to protect coral reefs. IYOR 2008 is a yearlong campaign of events and initiatives hosted by governments, individuals, corporations and schools around the world. The campaign aims to promote conservation action and strengthen long-term constituencies for coral-reef conservation. The IYOR 2008 campaign consists of a wide range of events and activities that take place throughout the year and around the world. Projects range from science workshops and report publications, to beach cleanups and art exhibits.

Healthy coral reefs provide:

- **Habitat:** homes for more than a million diverse aquatic species, including thousands of fish species
- **Income:** billions of dollars and millions of jobs in more than 90 countries
- **Food:** for people living near coral reefs, especially on small islands
- **Protection:** a natural storm barrier that protects coastal cities, communities and beaches
- **Medicine:** the potential for treatments for many of the world's most prevalent and dangerous illnesses and diseases

Everyone is welcome and encouraged to participate in IYOR 2008. The Web address is www.iyor.org.

The International Year of the Reef was officially launched on the evening of January 24th, 2008 in Washington, D.C. Guests—including government representatives, organizations, embassies, the corporate sector and the conservation and scientific community—gathered from around the world to attend the event. Remarks were given by, among others: Claudia McMurray, U.S. Department of State, Assistant Secretary for Oceans, Environment and Science; Noah Idechong, Vice Speaker of the Palau House of Delegates; Conrad Lautenbacher, Administrator of the National Oceanic and Atmospheric Administration (NOAA); and Drew Richardson, President and Chief Operating Officer of the Professional Association of Diving Instructors (PADI). With their presence and their speeches, they demonstrated the importance of the IYOR campaign.

In addition to the formal launch in Washington, many other activities and launches have taken place around the world, and many more are scheduled. Especially noteworthy, IYOR is partnering with World Ocean Day and World Water Monitoring Day to promote coral-reef conservation.

The next time you plan a trip, therefore, to visit, surf or snorkel at a coral reef, please take a minute to consider that reefs are among the most threatened ecosystems on the planet. Please help spread the word that reefs can be protected—for our enjoyment, the health of the planet, and future generations.

For more information:

About coral reefs:
<http://www.iyor.org/reefs/>
IYOR calendar: www.iyor.org/Calendar/events_list.aspx
IYOR focal points page:
www.iyor.org/focalpoints/
IYOR Educational Material:
www.iyor.org/resources/education.asp

The author, Francis Staub, is the International Coordinator of the International Year of the Reef for the International Coral Reef Initiative, and a consultant with AJH Environmental Services.

A CONTINUING SERIES

Part 2c & 3: Science Behind Synthetic Sea Salts From the Labs of Instant Ocean

Visit www.instantocean.com to read Part 2b of this continuing article, found in the Vol. 24, Spring 2008 issue.

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2. Instant Ocean

c. Reef Crystals

Reef Crystals is a specially formulated synthetic sea salt made by Instant Ocean for use in aquaria with soft and hard corals. It has all the features and benefits of Instant Ocean, with added calcium, some vitamins and trace elements. It also contains a special additive to detoxify heavy metals such as copper.

Hard corals remove calcium from the water as they grow, and this calcium needs to be replaced—either through supplementation with a calcium additive or by water changes with freshly made seawater. A regular schedule of water changes with seawater made with Reef Crystals can, in many cases, lessen the need to use a calcium supplement. As mentioned, Reef Crystals also contains certain vitamins and trace elements, but the amounts and specific types are proprietary, so they cannot be discussed here further. Research shows, however, that the substances added are beneficial to soft and hard corals in aquaria.

3. Sources of Seawater for Your Marine Aquarium

A few terms need to be defined that will usually be abbreviated in this paper. These include:

Natural seawater (NSW)—seawater collected from an ocean or sea. It may be further processed by mechanical filtration or with ultraviolet sterilization, but the original source is the ocean and nothing is added to the water.

Synthetic sea salts (SSS)—a mixture of two or more chemical compounds to make a medium that, when dissolved in freshwater, approximates the general chemical composition of natural seawater. Evaporated, augmented or

concentrated sea salts and seawater also fall under this category, since they are altered in comparison with natural seawater.

a. Natural Seawater.

While it may seem at first, as mentioned previously, that it would be preferable to use natural seawater rather than synthetic sea salt—because, after all, this is what the fish and corals live in—one can make a case for exactly the opposite. The greatest problem with NSW is that the NSW to which the vast majority of people have access would come from the shore or beach near a major metropolitan area; for example, Los Angeles, New York or Boston. The NSW in these areas is not what tropical marine fish and corals live in. Typically, near-shore waters are polluted from runoff water, and the air in these areas is polluted due to heavy vehicle traffic and industrialization. Even public aquaria located on the coast face these problems. Whether they can use the NSW next to their facilities depends upon many factors. Monterey Bay Aquarium uses NSW, but they draw the water from deep in the ocean, since there is a submarine trench just offshore from their facilities. Similarly, the Aquarium of the Pacific, in Long Beach, Cal., sends a barge out several miles from the shore to collect NSW and bring it back to the aquarium. The National Aquarium in Baltimore, on the Chesapeake Bay, uses its own SSS formula to make seawater, since the water around the facility is so polluted from past factory operations.

b. Synthetic Sea Salts.

The first SSS formulations are as old as marine aquarium keeping itself. Gosse, who generally is credited with setting up and operating the first marine aquaria, presented some details about them in his book published in 1854. He also published a communication in the

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