Our Ocean Backyard

Gary Griggs

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Our weather in recent months seems to be all over the map. Record winter snowfall in the Sierras and then very warm weather predicted for the Lake Tahoe area with the very real concern that warm days will melt enough of the snowpack to produce serious downstream flooding. Living along the coast next to the Pacific Ocean provides us with a temperature buffer or moderating effect. Yet we have had snow on the beach in Santa Cruz on several occasions and also had some very sweltering days here.

The hottest day ever recorded in Santa Cruz took place on August 1, 1900, when the thermometer hit 108 degrees. But the warmest continuous spell took place in late-June 1976, in the middle what was our most extreme two-year drought. On June 23 the temperature reached 100 degrees, and for the next five days, the thermometers hit 106, 105, 103, 105, and then cooled slightly to 103 degrees on June 28. This is not typical or normal, but as the planet continues to warm, these temperatures will likely occur more frequently.

While the offshore ocean acts as our natural air conditioner, the oceans are also heating up. Two weeks ago, a new study reported that the surface temperatures of the world’s oceans reached their warmest levels in modern history this year, exceeding climate forecasts. These increasing temperatures, particularly this spring, are concerning the scientists who study ocean warming and global climate. The ocean has been a major recipient of the huge amounts of carbon dioxide generated by humans over the past 150 or so years since the Industrial Revolution. Ocean water has absorbed about 90% of the increased heat with the top few meters of the ocean storing as much heat as the Earth’s entire atmosphere.

In 2021, global emissions of carbon dioxide from fossil fuel combustion, as well as from the production of cement and the burning of vegetation, reached 40,700,000,000 tons and were projected to rise nearly one percent more in 2022. On the positive side, the United States has made some progress in actually decreasing our carbon dioxide emissions slightly, cutting them back by eight percent from 1990 to 2020. It’s important to celebrate our progress, but in 2021, despite having just 4.5% of the global population, we emitted 14% of the planet’s carbon dioxide.

We have a whole lot more to do in order to reduce our emissions, and in the meantime, as each day and month goes by, the oceans are continuing to get warmer. You might ask – Wouldn’t that be a good thing? It would seem so around Monterey Bay where I’m certain that anyone who spends any time at all inthe ocean here would be delighted to have warmer water. This week the water off Santa Cruz has been about 52 degrees, and at its warmest, in late summer, it can get up to about 66 degrees. The generally accepted range in water temperatures for comfortable ocean swimming, however, is about 77 to 82 degrees. We aren’t even close.

Most marine life is adjusted to the ocean temperatures they live in. Marine mammals like whales, seals, sea lions and dolphins, for example, have a healthy thickness of blubber insulting them from cold water. Sea otters do not, but they have an important coating of very fine fur that, as long as it’s clean, can hold air that insulates them. For most of us, however, we don’t have either.

But for most other marine life, ocean water temperature is a very limiting factor for where they can live and thrive. And when the water gets warmer, they have to migrate, adjust somehow, or there are negative consequences. For many organisms there is a thermal death point when the water gets too warm and they expire for a range of metabolic or physiological reasons. It’s like being in a hot tub that is say, 110 degrees, for a prolonged period of time.

One very important group of organisms are the reef-building corals that are very negatively affected by an ocean that is warmer than their acceptable temperature range. Reefs are recognized as having many benefits and playing important geologic, biologic, and economic roles throughout the tropical oceans of the world. Most marine biologists consider coral reefs to be the most diverse communities in the oceans, in part because they foster a huge diversity of species, surpassing even the tropical rain forests. Reefs provide shelter, food and breeding and nursery grounds for an estimated 35,000 to 60,000 species worldwide, including about one-third of the planet’s estimated 25,000 to 30,000 species of marine fishes.

Perhaps a billion people around the world depend to some degree on coral reefs for food and for fishing income. Visitors to tropical areas and income from tourism have grown substantially in recent decades, and it is estimated that many countries, island nations, or areas with reefs derive over 50 percent of their overall income from tourism. In many cases tourists come to experience those beautiful coral reefs.

Coral reefs also can serve as an important role in providing protection for coastal communities, development, and infrastructure by resisting attack by storm waves, hurricanes and typhoons. The buffer or barrier provided by strong, healthy reefs helps reduce shoreline erosion and coastal flooding and comes at no cost. Reefs can also adjust to rising sea levels because corals are generally able to grow upward, keeping pace with sea-level rise.

However, coral reefs are generally restricted to areas of the ocean between 30 degrees north and south of the equator where ocean temperatures year-round are between about 68 to 86 degrees F. (20-30 degrees C.). Reef building or hermatypic corals are a symbiotic relationship between an animal (a coelenterate) and a plant (an algae called zooxanthellae), whereby the algae normally provide the coral with up to 80-90 percent of their energy through photosynthesis, making them essential for coral survival.

When corals experience stress, typically when the water is much warmer than normal, they can expel their algae for unknown reasons, and turn white, or become “bleached”. There is a chance that bleached coral can survive and recover if conditions return to normal quickly enough. However, in the face of other human-induced pressures, corals have become vulnerable. In many cases, bleached coral colonies die.

Global warming is increasing the surface temperature of the oceans as well as the atmosphere. On shorter time scales, El Niño events lead to changes in ocean circulation and water temperatures over large areas of the tropical oceans that may last for several months or longer. It has been these events in recent decades that have produced an increasing number of prolonged, widespread and devastating bleaching events on reefs.

All indications are that a significant El Niño is now forming in the equatorial Pacific that will affect the global oceans this fall and winter, including the California coast. On top of that, however, the observations this spring of the surface waters of the ocean being the warmest ever recorded in human history, are indicators that our oceans are changing in a way that will have long-lasting impacts on marine life and ecosystems, including coral reefs.