

THE CURIOUS CASE OF THE GLOWING BEACHES

Relevant for: Environment | Topic: Environmental Conservation, Sustainable Development, and EIA

PANJIM : Just over a month ago, in remarkable unison, several separate communities arrayed on India's coastline alongside the [Arabian Sea](#) reported the presence of sparkling waves—the technical term is bioluminescent—which looked like they were embedded with blue-green glitter, and they kept rolling up to the shore one after another every night. Sizable crowds assembled to admire this “magical effect” at Juhu Beach in Mumbai, Udupi and Mangalore in Karnataka, as well as the Kochi waterfront in Kerala.

In my home state of Goa, the shimmering tides surfaced on the north and south beach belts, as well as the Mandovi and Zuari river estuaries. But no one cheered, because they came accompanied by dense swarms of [jellyfish](#), including species that are known to be toxic. Over just two days in late-November, 90 tourists were stung badly enough to require treatment, after which the panicked authorities stopped releasing data.

Before and after this cryptic natural event, as clearly visible from where I live near Miramar beach in the pocket-sized capital city of Panjim, thousands of these gelatinous creatures continue to wash up every day, with innumerable others bobbing just offshore.

The two phenomena—sea glitter and jellyfish, beauty and danger—are inextricably interlinked. Together, they represent yet another pressing warning about the ill-health of our oceans, which is profoundly connected to broader planetary trends associated with [climate change](#).

At the base of the problem is a drastic dwindling in oxygen levels in the Arabian Sea—a phenomenon known as hypoxia. This is caused by a variety of triggers that are just beginning to be understood by scientists, but sewage run-off from megacities and a drastic reduction in freshwater flows due to the loss of Himalayan snow cover are early suspects. The collapse in oxygen, however, allows malodorous, bioluminescent “sea sparkle” *Noctiluca scintillans* to flourish, which in turn leads to an explosion in the population of predatory jellyfish and salps (another gelatinous creature), eventually resulting in a disruption of the ocean's intricate food chain.

We have been seeing warning signs for years, but what is now playing out along the Konkan and Malabar coasts indicates that a perfect storm of devastating climate change-induced fallouts is already at India's doorstep.

“I wish I could sound optimistic, but I think the Arabian Sea ecosystem is past its tipping point,” said Joaquim Goes of Columbia University's Lamont-Doherty Earth Observatory.

Early last year, in May, he joined nine co-authors in publishing an important study in the *Nature Scientific Reports* journal entitled *Ecosystem state change in the Arabian Sea fuelled by the recent loss of snow over the Himalayan-Tibetan Plateau region*. It highlighted “exceptional changes” which “represent a significant and growing threat for regional fisheries and the welfare of coastal populations”.

Even as recently as the middle of 2020, the emphasis had still not been on India, but remained focused on the opposite shores of the Arabian Sea—on countries like Oman where desalination plants, refineries and other industrial complexes have become choked by jellyfish.

Even more dramatic are the effects in Yemen and Somalia, where there are strong suggestions

that the Noctiluca blooms and their strangling of fish supplies have greatly exacerbated food and economic insecurity, thus triggering the ongoing social destabilization, militarism and piracy that roils that region.

Alarm bells

When their research was published, Goes presciently alerted that “exactly the same changes that we report along the coasts of Oman and Yemen are happening on a smaller scale not too far from our (Indian) shores.” He had pointed out that Noctiluca was clearly present near Ratnagiri and Vengurla in Maharashtra, and warned unequivocally that “our planet’s alarm bells are ringing. There are very serious implications for India. All the hard-won economic gains of the past two decades could be wiped out now, just as the pandemic has done for the US.”

Fast forward just six months later, and now Goes is much more worried. He says the situation has become significantly worse. When I emailed him to tell him what has been happening on Miramar beach, he responded that it looked like an end game, which has “the propensity of short-circuiting the entire food chain, because, when Noctiluca abounds, the apex predators are not fish, but swarms of jellyfish and salps. The environmental and socio-economic costs can be huge as these swarms can clog the intake systems of all kinds of industrial plants, and also inflict huge economic losses on tourism and fisheries.”

Goes pointed to the newly published findings in Reviews and syntheses: Present, past, and future of the oxygen minimum zone in the northern Indian Ocean, which was published recently in Biogeosciences by Tim Rixen of the Leibniz Centre for Tropical Marine Research in Germany, and several co-authors.

Collaborators from nine different international institutions (which include the Physical Research Laboratory in Ahmedabad) discovered there are worrisome and seemingly self-perpetuating signs of “functional anoxia” (which means the lasting lack of sufficient oxygen to maintain normal ocean biodiversity) in the Arabian Sea. They reported widespread conditions in which Noctiluca flourishes, but almost nothing else can survive.

I immediately wrote to Rixen to ask for some perspective about what is happening in the ocean waters of India’s Arabian Sea coastline, and he responded, “I am not surprised but worried, because it indicates a regime shift caused by the expansion of the oxygen minimum zone [or OMZ, where oxygen saturation in the sea water is at its inhospitable lowest]. I could imagine that this will affect fisheries, as well as the role of the marine biosphere as an essential store of carbon dioxide.”

Rixen elaborated, “functional anoxia means that anoxic microbial processes start to dominate the ecosystem, even though trace amounts of oxygen are still present. This occurs naturally in mangrove soils and marine sediments, but only rarely in the ocean. At such low oxygen concentrations, the productivity of marine systems could fall and the formation of greenhouse gases could rise.”

Put more simply, these inhospitably low concentrations of oxygen are markedly below the percentages needed for most organisms to survive. This means India’s western coast is on the verge of mass mortality events, in which most fish—including the varieties that humans rely on for nutrition—will die en masse.

The causes

How did we get to this desperate state of affairs that imperils the lives and livelihoods of millions

of Indians as well as all the other communities that live near the Arabian Sea? One big reason is sewage: thousands of megalitres (the metric equivalent of a million litres) of untreated waste are released every day from megacities like Karachi and Mumbai, as well as every other coastal community in this part of the world.

Even in tiny Goa, as far back as 2011, the National Institute of Oceanography (NIO) had already cautioned that all coastal waters and rivers are so thoroughly contaminated with E-coli (faecal) bacteria that they're actually unsafe for swimming.

Another significant factor is the inexorable grinding logic of climate change. In their Nature Communications paper, Goes and Gomes et al wrote: "The recent trend of global warming has exerted a disproportionately strong influence on the Eurasian land surface, causing a steady decline in snow cover extent over the Himalayan-Tibetan Plateau region. This loss of snow is undermining winter convective mixing (which aids marine biodiversity, in turn supporting humans who rely on fisheries)."

These twin processes—urban run-off into the Arabian Sea, and climate disruption due to global warming—have been at work for many years, but no one expected how quickly they could wind up wrecking the ecological balance.

After all, the first sizable presence of Noctiluca in the Arabian Sea was found as recently as 2000 by the NIO scientist Prabhu Matondkar (he has since retired), who says he was initially rather taken aback to find "massive green tides in the open ocean". It took another full decade of research for Matondkar to arrive at the realization. "This new bloom had come to stay."

But now, Matondkar, who lives in Goa and continues to pay close attention to the ocean, is quite alarmed. He told me what has happened on our shores in recent weeks is "beyond expectation". "Noctiluca means the end of the food chain as we know it. It poses major challenges to us, and our world, in the coming decades," he said.

"We have to study and understand the ecology of this organism fully, or we will not be able to manipulate the situation back in favour of the natural flora of our marine ecosystem. If that does not happen, there is going to be disaster for our environment, and the resources we need to survive," Matondkar added.

Future uncertain

In Understanding the dietary relationship between extensive Noctiluca bloom outbreaks and Jellyfish swarms along the eastern Arabian Sea, another new paper published in August in the Indian Journal Of Geo Marine Sciences, L. C. Thomas, S.B. Nandan and K.B. Padmakumar of the Cochin University of Science and Technology explained in detail what is now occurring on a giant scale along the entire western coastline.

Describing how closely Noctiluca and jellyfish overlap, thus driving concomitant increases in each other's population, they write "the increasing jellyfish population feeds on mesozooplankton and provides favourable conditions for N. scintillans to [flourish] by feeding on diatoms with less competition. With the plentiful availability of N. scintillans cells, these jellyfishes utilize them as a food source [which in turn leads] to jellyfish swarming." All this is the definition of "a disrupted food chain characterizing an unsustainable and less diverse ecosystem."

When I wrote to ask whether he was surprised about just how bad the situation had become in the marine environment off the western coastline, Padmakumar gave me a measured response, saying "We can't say that it is permanently being compromised. Of course, there are many

disruptive changes occurring in the Arabian sea ecosystem like habitat destruction, debris accumulation, microplastic pollution increase, and an increase in harmful algal blooms. However, there is some kind of resilience undertaken by these ecosystems that try to recoup toward a healthy state. This continuously happens but the limit of this resilience is questionable."

An identically hedged but distinctly ominous position was also taken by Rixen when I asked whether what we are seeing now marks a point of no return for the health of the Arabian Sea.

He cautioned, "One has to look at causes. Solving the problem of eutrophication (the term refers to accumulation of sediments, minerals and nutrients) and pollution is largely related to socio-economic issues, while global warming impacts will most likely be irreversible on interannual to decadal time scales, even if the Paris agreement (to reduce greenhouse gas emissions) will be implemented. This is largely caused by the slow response of the ocean to changes of the atmospheric temperature. Whether regime shifts will be reversible, I do not know."

For his part, Goes is clear that we are in a dire situation. He says we that have no choice but to act collectively and immediately to "limit our carbon footprint, and look to sustainable energy alternatives—such as solar and wind—to power our homes".

"We have to reduce our dependence on fossil fuels, especially coal, by incentivizing industries and homes to switch to renewable sources. This drastic loss of snow, if it continues, will permanently disrupt the monsoon rainfall cycle which drives our agricultural sector, and we are already seeing early signs of erratic and sometimes extreme rainfall patterns," he added.

Goes' prognosis is a grim one: it is clear our fisheries are now gravely threatened by the disruption of the marine environment. India's food security is at stake.

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