Western Indian Ocean phytoplankton hit by warming

- K.S. RAJGOPAL

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Phytoplankton (microscopic marine plants) populations in the Western Indian Ocean have declined by 20 per cent over the last six decades according to a recent study published in Geophysical Review Letters. This decline has strong implications for the ecology of the region as it seriously affects the ocean food web and has already been reflected in a decline in fish catch in the region and poses a threat to food security in the Indian Ocean rim countries and also the global fisheries market.

The study says that the main reason for the decline in the phytoplankton is increased sea surface temperatures which suppress the mixing of surface and subsurface waters. The increased sea surface temperatures result in less dense water in the surface, a process known as stratification. Though the surface waters are exposed to sufficient sunlight required for photosynthesis of these plants, the nutrients (nitrates, phosphates and silicates) from the lower depths do not reach the surface due to stratification. Meanwhile, the subsurface phytoplankton do not have access to sunlight for photosynthesis and growth even though they have access to nutrients at the lower depths. This leads to less phytoplankton as these marine plants are asexual and multiply by cell division as they grow and reproduce in the presence of sunlight and nutrients.

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Future climate projections, however, suggest that the Indian Ocean will continue to warm, driving this productive region into an ecological desert. It is imperative to have a firm understanding of the trends in productivity in this highly productive ocean basin, especially since it has been experiencing one of the largest warming trends over the tropical oceans. Short-term studies in the past have indicated that the Western Indian Ocean underwent the second largest increase in chlorophyll concentrations (indicator of phytoplankton biomass) among the open ocean regions.

One study reported an increase of up to 350 per cent in marine phytoplankton in the Western Indian Ocean and pointed to strengthening of summer monsoon winds in the Western Indian Ocean as a factor that led to upwelling and mixing of subsurface phytoplankton and nutrients. However, long-term studies such as this one led by Dr. Roxy Mathew Koll, scientist, Indian Institute of Tropical Meteorology, Pune are needed for attribution of changes in phytoplankton to ocean warming.

Changes in plankton production can have immense impact on marine species as well as humans who rely on them as a source of food. Downward trends in primary production over these areas can be detrimental to the marine food webs and the fishing industry. Data from the Food and Agriculture Organization of the United Nations (FAO) show that the Indian Ocean accounts for 20 per cent of the total tuna catch, especially the most economically valuable bigeye tuna, making it the second largest supplier to world markets. Large-scale distribution of these dominant species of tuna are associated with the phytoplankton availability and abundance.

Along with short-term satellite data, the study used historical simulations to track the long-term trends in the warming of the western Indian Ocean. These simulations are prepared from pre-industrial times to the present using a yearly rate of increase in CO2. However, the yearly changes in ocean and atmospheric conditions are not given to the model. So the model output would be a response to the increasing CO2 and consequent greenhouse warming. "The other factors are driven by natural variability, for example the El Nino Southern Oscillation (ENSO). The ENSO cycle in these model simulations and observations are not in sync i.e. they don't occur at the same time. So year to year comparison is not possible," writes Dr. Roxy Mathew Koll in an email to this correspondent.

During the 1998 El Nino, the winds over the Western Indian Ocean were weakened. Weakened winds mean less evaporation, i.e. more warming. In the next year, 1999, a La Nina occurred. During La Nina, these winds got stronger, leading to more evaporation and cooling. The cooling led to a temporary spurt in phytoplankton populations during 1999-2000, but over the long term the populations declined as the
ocean got steadily warmer.

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