

Determining the Impacts of Tropical Cyclones on Pre-Monsoon Phytoplankton Assemblages in the Arabian Sea

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The EKAMSAT (Enhancing Knowledge of the Arabian Sea Marine environment through Science and Advanced Training) research cruise took place in the Arabian Sea from June 9th to 26th, 2023. Its purpose was to investigate oceanic and atmospheric properties and interactions prior to the onset of the summer monsoon season (pre-monsoon), during which this tropical region is highly oligotrophic and stratified. An additional purpose was to observe how the arrival of the summer monsoon causes upward shoaling and nutrient enrichment of the Arabian Sea's upper euphotic layer, in turn producing large phytoplankton blooms. Cyclone Biparjoy, which traversed across the western Arabian Sea from 6th June 2023, and made landfall on 16th June 2023, accelerated this sequence of events. It serves as an analog for the summer monsoon onset in terms of its ability to cause mixing of the surface and subsurface water and its effects on phytoplankton assemblages. We observed an average four-fold increase in biomass in cyclone-impacted regions relative to those still under pre-monsoon oligotrophic conditions. There was also a significant shift in community composition in terms of dominant functional types from cyanobacteria in still-oligotrophic regions, to large diatoms in cyclone-impacted regions. These changes have major implications for ocean biogeochemical processes and ecosystem functioning, as well as on humans, 150 million of whom depend on Arabian Sea fisheries for food or economic livelihood. We discuss the broader implications of our findings in the light of current and anticipated increase in tropical cyclone frequency and intensity in the Arabian Sea.