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Editorial: Coastal and marine environmental quality assessments

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Editorial on the Research Topic
Coastal and marine environmental quality assessments

Seawater quality has a considerable impact on the biological productivity and ecological viability of coastal and marine environments (Dheenan et al., 2016; Yuvaraj et al., 2018; Ratnam et al.). Anthropogenic pressure has continuously grown due to population expansion and industrialisation in coastal areas, which has led to a decline in seawater quality along the coast. The environment and ecology have been severely damaged owing to the release of large amounts of pollutants through anthropogenic and natural catastrophes into the coastal and marine ecosystems. As a result, coastal pollution has grown to be a global problem that has to be addressed by using monitoring programs and a mitigation management system.

The physical, chemical, and biological components of coastal and marine ecosystems have a significant role in their productivity and sustainability. These ecosystems have been and continue to be significantly impacted by anthropogenic pollutants. More than 80% of all marine pollutants come from land-based sources, the bulk of which are commercial, agricultural, and urban in nature. Coastal and marine pollution is increased by human activities including offshore gas, oil extraction, and transportation.

Preventing and controlling coastal and marine pollution as well as developing better monitoring techniques and systems are essential for a better understanding of the spatial and temporal variations in seawater quality (Jha et al., 2015). Analyzing real-time data and its effects on the marine ecosystem requires the use of data buoys, remote sensing, and other cutting-edge technological advancements in coastal and marine water quality monitoring.

To analyse physicochemical and biological variables and other environmental issues including harmful algal blooms (HABs), heavy metal pollution, bioaccumulation, and eutrophication, it is necessary to create techniques for analysing long-term ecological data from the coastal and marine environments. The surveillance program provides huge datasets that are extremely useful for determining the health of the marine ecosystem. The approach for analysing environmental factors must be improved in light of current technological breakthroughs to meet the scientific demands for large dataset analysis and understanding. The physicochemical properties of water, phytoplankton, zooplankton, nutrients, metal toxicity, benthos, microorganisms, ocean acidification, micro-plastic, and sediment quality are important variables that need to be monitored (Dheenan et al., 2014; Pandey et al., 2021; Kumar et al., 2022; Pandey et al., 2022). The research is further extended to look at modelling approaches, newly created statistical tools, or a combination of techniques or biotic index in the coastal and marine environment, concentrating on interactions between land and seawater.

Impact of physicochemical and biological variables

The physicochemical and biological variables are very important for ecosystem maintenance and management. Josephine et al. reported that *Chlorella vulgaris* grows better at 25°C (temperature), 8.0 (pH), 30 PSU (salinity), and blue light (499–465 nm) and further revealed that optimized environmental conditions could increase growth rate and biomass. Lee et al. suggested that hypoxia can affect the mesozooplankton abundance and its occurrence in Gamak Bay and revealed that three cladocerans species like *Pleopis polyphemoides, Pseudoevadne tergestina*, and *Penilia avirostris*, as well as the copepod Acartia sinjiensis, were the dominating species during the hypoxic phase. Jeong et al. found that rainfall causes zooplankton distribution to change in temperate estuaries, as well as changes in salinity and suspended particulate matter. Sun et al. experimentally demonstrated, through a mesocosm experiment that the impact of disturbed sediment on ocean water. The findings demonstrated that the levels of dissolved oxygen (DO) decrease significantly and those of nutrients increased gradually after the addition and stirring of the aquaculture sediment; in specific, the levels of ammonia and dissolved inorganic phosphorus increased considerably. Joshi et al. found that among the four mercury-resistant bacteria (MRB) that were isolated from the equatorial region of the Indian Ocean (ERIO), NIOT-EQR J251 was the most effective at removing mercury from culture media. Zhang et al. divided the Pearl River Estuary (PRE) coastal waters into three sub-areas: freshwater (Zone I), mixed (Zone II), and seawater (Zone III) to establish integrated land-ocean unified nutrient criteria and water quality assessment as well as the implementation of effective coastal eutrophication regulation in the future. According to Zhou et al., clean marine emissions and secondary aerosols were the main sources of total suspended particles and water-soluble inorganic ions. Further, heavy industrial activities and excellent air quality in Zhanjiang could be explained by the high precipitation frequency (63%) and the marine dilution effect (27%). According to Jian et al. mixing of various water masses is crucial for regional, physical and biogeochemical mechanisms as well as for the ocean ecosystems. The mixing of water masses in the Pearl River Estuary and the surrounding northern South China Sea was studied quantitatively using a unique dataset of stable water isotopes (δD and δ18O), temperature, and salinity profiles.

The ecological function of benthos

Benthos are very essential for ecosystem functioning as they play important roles in the energy flow, sediment reworking, cycling of organic matter and nutrients and serve as an indicator to assess the integrity of the ecosystem (Pandey and Ganesh, 2019). Nayak et al. found that Mahanadi Estuarine System is subjected to intense human activity and abound three major benthic faunal groups influenced by tolerant/opportunist species proved with hierarchical clustering analysis. Xu et al. reported that the structure and composition of benthic fauna are significantly impacted by bottom trawling. Furthermore, when a region is subject to hypoxia, bottom trawling may help to increase the level of DO, leading to a higher level of diversity in the trawled area compared to the non-trawled area in the summer. Pandey et al. found that the environmental perturbation during the monsoon season brings significant changes in physicochemical and biological characteristics whereas non-monsoon season revealed a healthy benthic environment in Diu Island.

Marimuthu et al. evaluated the Lakshadweep Archipelago's benthic environment for the geographic variability of the negative biological indicator *Drupella cornus* and its preferred coral species *Pocillopora verrucosa* during the research. Lei et al. examined the quantity and distribution of *Drupella* spp. concerning coral-prey availability, selectivity, and nutritional value suggests that the particular reef habitat and environmental factors may change the prey preference of Drupella spp. Benthic fauna is considered an important indicator and hence Ravi et al. found that regular monitoring programs of the coastal and marine environments might make use of biomarkers to evaluate naphthalene exposure and toxicity in marine creatures (*Perna viridis*).

Heavy metal and its ecological impact

The anthropogenic activities and natural events (like dust deposition, volcanic eruptions, and mineral weathering) cause trace metals to enter the coastal and marine environment (such as mining, burning fossil fuels, agriculture, industry, marine traffic, urbanization, and sewage release) (Sundararajan et al., 2016; Jha et al., 2019; Satheeswaran et al., 2019; Jha et al., 2021). Metal bioaccumulation in the marine ecosystem poses a threat to the flora and fauna and ultimately human beings in the food chain. Zhou et al. revealed the distribution patterns of six metals (Zn, Cu, As, Pb, Cd, and Hg) in the seawater, sediments, and living organisms in Jieshi Bay, it is crucial to preserve the quality of the seawater due to bioaccumulation from seafood and associated products. Wu et al. discovered that the fast urbanization and industrialization in the coastal Zhuhai had caused serious metal contamination and demonstrated that Cu, Zn, and Pb exceeded the standards of seawater, confirming the existence of anthropogenic contamination. The findings of the environmental vulnerability assessment also revealed that the environmental hazards for Cd and Cu were high. Manasi et al. estimated heavy metal concentrations of cadmium, lead, and mercury in different organs of Asian Seabass, *Lates calcarifer*, aimed of determining the associated risk from fish consumption. The results suggested that the metal level in the fish muscle was well within the recommended level for seafood in the Rameswaram coastal region, southeast coast of India, and safe for human consumption.

Ocean acidification and its ecological impact

Long-term pH decreases in the ocean are referred to as ocean acidification (OA), and they are mostly because of atmospheric carbon dioxide. Srinivasan et al. found that ocean acidification has an impact on the haematological and biochemical components and also had an impact on physiology such as growth in *L. calcarifer*, with the impact being stage-specific and pH-dependent. Marcus et al. highlighted the difference between two distinct size groups of fish when exposed to an acidic environment and how the immune system in *L. calcarifer* is modulated. Furthermore, it has been established that the CO_2 driven acidification of seawater affects several stressors, with the rising H+ level being just one of them. Wei et al. conducted a forty-two days laboratory experiment to ascertain how *Halimeda opuntia*, a calcifying macroalga, responds to varying pCO_2 under OA conditions in terms of growth, biological performance, and associated carbon and nitrogen metabolic products (1200 ppmv). It is evident through their study that increased pCO_2-related stress, greater free amino acid level, and proline secretion were connected to maintaining the integrity of algal cellular structures.

Micro-plastic and its impact on fauna

A ubiquitous and persistently threatening global environmental problem is the pollution of the oceans with microplastics (MPs). Over the past fifty years, the annual production of plastics has more than doubled, with an estimated 335 MT of production in 2016. (Galgani et al., 2015; Plastics Europe, 2018). Plastics are a significant contributor to marine pollution because they are present in a wide range of terrestrial and aquatic ecosystems. MPs contaminations endanger marine life and have significant consequences on ecosystems. Janardhanam et al. noticed MPs consumption in demersal sharks taken during trawling in marine seawaters beyond 80 m depth along the Southeast coast of India and discovered 4.67 pieces/shark in which the gastrointestinal system revealed more MPs compared to the gills. Pandi et al. discovered that exposure to weathered Polyethylene (wPE) microplastics affected the glutathione-S-transferase enzymes in zebra fish. This study also discovered that wPE microplastic exposure changed the levels of gene expression for the biotransformation enzymes, which raises the possibility that these enzymes might be used as helpful biochemical markers for determining microplastic exposure in coastal and marine environments.

Seawater quality modelling

Planktons are a diverse collection of organisms found in water that are unable to swim against the water current and are categorized as phytoplankton (plants) and zooplankton (animals). Phytoplankton is small plants among the plankton population and is regarded as the main source of energy in the aquatic environment. Zooplankton and fish species that eat plants use phytoplankton as food. Thus, variation in the biomass and composition of the phytoplankton population regulates the zooplankton composition, which eventually has an impact on fisheries productivity (Schroeder, 1983). Any water quality may be estimated with ease and at a low cost using numerical modelling and remote sensing; nevertheless, field data are necessary to validate the model. Geng et al. found that the spilling of oil is a normally unexpected occurrence that is negative to the ecosystem, its flora, and fauna, however, a numerical model demonstrated that wind direction played a dominating role in the direction of the dispersion of oil in the northern South China Sea. Geng et al. also observed the impact of thermal pollution caused by the cooling water discharge of power plant on the surrounding marine ecology and established a high-resolution 3D cooling water discharge model based on the ECOMSED model in Daya Bay and the model were consistent with the observation results on the distribution of time series of tide level and temperature. Xiu et al. discovered that high concentration patches at the edge area between mesoscale eddies, which were high compared to those in the cyclonic eddy core area in the northern South China Sea (NSCS) as per the observation of the satellite chlorophyll data (May 2015). A high-resolution physical-biological model was used to analyze the underlying mechanisms, highlighting the necessity of high-resolution measurements and the significance of sub-mesoscale processes on phytoplankton dynamics in the NSCS. Pradhan et al. discovered that a coupled hydrodynamic-water quality model had been built to simulate and predict coastal water quality parameters and that the model's performance for both hydrodynamics and water quality was within reasonable limits for up to three days of prediction. Sarkar et al. discovered that species may survive in a noise-induced system due to rhythmic fluctuation in biomass, change in carrying capacity, lack of competitive exclusion, and non-equilibrium conditions. Another putative coexistence mechanism was discovered to be high amplitude species biomass fluctuation at greater ambient noise. Additionally, a change in the mean niche conditions of the species was seen along with the change in ambient noise.

Author contributions

DJ and TG: original draft preparation and writing. MW and PD: reviewing and correcting the editorial. All authors contributed to the article and approved the submitted manuscript for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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