

Review

Expansion of Toxic Algal Blooms in Coastal and Marine Areas in the Philippines and Malaysia: Is It Climate Change Related?

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Abstract: This paper provides a review of toxic algal blooms in the Philippine and Malaysian coastal and marine systems, considering relevant available knowledge, including climate change dimension/s in the assessment of their recorded recent expansion. The first record of human toxicity in the Philippines associated with HABs/toxic algal blooms specifically was during the bloom of *Pyrodinium bahamense* in the Sorsogon, Samar, and Leyte waters in 1983. Since then, the species has been identified to occur and cause blooms in about 44 sites/areas in the country. Recent government reports, i.e., 2021, 2022, and 2023, have also identified other paralytic shellfish poisoning (PSP) causative organisms (*Gymnodinium catenatum*, *Alexandrium* spp.) in the country. New records indicate that the presence of PSP causative species has been reported almost year-round in the Philippines. In Malaysia, PSP caused by *P. bahamense* was initially confined in 1981 to the state of Sabah, Malaysia Borneo, but since then, blooms of this species have been reported almost annually at different scales across the coastal waters of Sabah. *P. bahamense* and other cyst-forming dinoflagellates could be transported naturally or through human activities. Other eco-physiological and environment factors from the field and the laboratory have been used to study the bloom dynamics and transport of PSP causative species in several areas in the Philippines and Malaysia. More recently, plastics and other marine litter have been considered potential vectors of invasion/transport or expansion of dinoflagellates with other microorganisms. ENSO events have been observed to be stronger since 1950 compared with those recorded from 1850 to 1950. The extreme phases of the ENSO phenomenon have a strong modulating effect based on seasonal rainfall in the Philippines, with extreme ENSO warm events (El Niño) often associated with drought and stresses on water resources and agriculture/aquaculture. In contrast, cold events (La Niña) often result in excessive rainfall. The La Nina Advisories from 2021 to 2023 (18 advisories) showed the persistence of this part of ENSO, particularly in regions with recurrent and new records of HABs/toxic algal blooms. More studies and monitoring of another type of toxic algal bloom, Ciguatera Fish Poisoning (CFP), are recommended in tropical countries such as the Philippines and Malaysia, which have extensive reef areas that harvest and culture marine fish for local and export purposes, as accelerating reports of this type of poisoning have apparently increased and causative organisms have been identified in several areas. There is an urgent need to enhance HAB/toxic algal bloom research and monitoring, particularly those related to climate change, which has apparently impacted these blooms/occurrences directly or indirectly. Local researchers and managers should be made aware of the knowledge and tools already available for their utilization and enhancement to meet local conditions and challenges for potential recurrence and expansion of HABs/toxic algal blooms. Regional and international HAB research and collaboration should be further advanced for the protection of public health and marine resources.



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