Spatial and Temporal Trends of Phytoplankton Community Structures Along the Kenyan, Coast.

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Marine ecosystems are facing multiple anthropogenic global changes, including ocean acidification, warming, and reduced nutrient supplies. Together, these challenges phytoplankton community structure. The base of Indian Ocean trophic structure is formed by phytoplankton varied communities which plays a significant role in the oceanic biological pump through the fixation of carbon dioxide, utilization of sunlight and the uptake of the dissolved nutrients in water, to provide energy readily available to the higher ranks of the food chain (Kiteresi et al. 2012). The common mechanisms controlling the distribution patterns depends on the physico-chemical parameters i.e. Injection of nutrients into the euphotic zone (Longhurst 2010). Due to their pivotal role in ecosystem functioning and biogeochemistry, phytoplankton have been the focus of global change research in marine ecosystems.

Results from the Tyro Expedition in the WIO under the Netherlands Indian Ocean Programme (NIOP, 1991-1995) established that the seasonal change in monsoon regime affect the nitrogen nutrition of marine phytoplankton conspicuously (Wafar et al., 2011). Seasonal variation of phytoplankton abundance and diversity is a common occurrence in many bays and creeks of the Indian Ocean. This is driven by the interchanging monsoon regime almost every half year as well as by water quality as result of land based activities.

The Kenya coastal waters receive inputs from major rivers (Tana, Sabaki, Ramisi and Umba) and effluents from towns (Mombasa, Malindi, Shimoni) that impact on the water quality crucial for phytoplankton proliferation. The upwelling waters and fresh water discharge from the Tana and Sabaki Rivers in the Northern coastal waters of Kenya enhance nutrient circulation for the primary productivity of the marine ecosystems, supporting marine life such as fish, crustaceans, molluscs and migratory species (seabirds and turtles) (Samoilys et al. 2015). It was in this area that harmful algal blooms were evident in 2002 in Kiunga leading to massive fish kills. Due to this, there was need for understanding the phytoplankton community structure of Kenya coastal waters hence this work offer a description of phytoplankton community structure focusing on their abundance and diversity, identifying hot spots for primary production over various time and geographical scales in the Kenya coastal waters.

Materials and Methods

Samples were collected along the Kenya coastal nearshore areas between 2009 and 2018 dependent on availability of funds. Seawater was filtered through a 20-μm mesh size phytoplankton net and transported to the laboratory for taxa identification and enumeration using the sedimentation technique as described by (Utermöhl, 1958; Arhonditis G.B et al., 2004). Striling, (1985) formula was used to estimate for plankton density. Phytoplankton cells were identified using identification keys by Botes, (2003) and Carmelo, (1997). Whenever possible, identification was carried out to the species level, although in some cases identification was only possible to genus level. Diversity indices (species abundance, diversity, richness and evenness) were calculated
following the standard formulae (Shannon and Weaver, 1949; Gleason, 1922; Pielou, 1966, Saravakumar et al., 2008). Statistica 12 was used for data analysis.

Results

Phytoplankton showed variation in the different marine waters along the Kenya coast. In Mombasa periurban creeks, phytoplankton abundance were high in 2011 in Tudor (5.23x10^4 cells/L) and Mtwapa (6.04x10^4 cells/L) with Makupa having abundance (5.08x10^4 cells/L) in 2014. Tudor (2.72) and Mtwapa (2.78) creek species diversity indices were high in 2016 with corresponding high species richness of 39 and 43 respectively.

The estuarine system, Sabaki river phytoplankton abundances (8.82x10^4 cells/L) were notably high in 2016 having the least species diversity index (1.12), evenness (0.46) and richness (13 species). Ramisi river had high phytoplankton abundances in 2010 (1.21x10^5 cells/L) and 2012 (1.48x10^5 cells/L) with the least species diversity (1.14), evenness (0.41) and richness (16 species) in 2010.

Within the Kenya marine waters in the north, Lamu showed high abundance (5.13x10^4 cells/L) in 2015 with high species diversity (2.85) and evenness (0.83). Phytoplankton abundances in Malindi (1.43x10^4 cells/L) and Kilifi (2.34x10^4 cells/L)) were high in 2015 with richness of 28 and 29 species respectively. The south part of the Kenya marine waters, Wasini recorded high abundances (9.01x10^4 cells/L), species diversity (2.69) and richness (37) in 2015. Kibuyuni phytoplankton abundances (3.76x10^5 cells/L) were high in 2014 which could be attributed to the initiation of seaweed farming activities in the area unlike the progressing years of which the activity has been highly intensified affecting its community structure. Sii Island in the south had abundance of 4.5x10^4 cells/L in 2014 which was the highest during the study period. This is of interest due to incidences of sand harvesting cases noted on the island.

Taxa abundances were high in 2010, 2012, and 2016 for Anabaena spp. and Coscinodiscus spp. (6.12 x 10^5 and 5.67x10^5 cells/L) in Ramisi; Navicula spp. (4.31x10^5 cells/L) in Kisite Mpunguti and Scenedesmus spp. (5.94x10^5 cells/L) in Sabaki respectively. These taxa have the potential of forming blooms resulting to oxygen depletion and eventually mortality of fish. Taxa known to be toxin producing causing PSP, ASP, DSP and CFP were recorded in this study such as Alexandrium spp.; Pseudo-nitzschia spp.; Gambierdiscus toxicus among others.

Conclusion

There is a decline in phytoplankton taxa abundance that correspond with an increase in its species richness. This implies that the phytoplankton community structure is evenly distributed. Worth noting is the increase in HABs taxa that have the potential to impact on the livelihoods dependents on marine fisheries. There is need for extensive phytoplankton studies on the in relation to the key marine environmental factors (biotic and abiotic) that dictates its community assemblages/structure.