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The Nature of Marine Coastal Ecosystems in the Tropics with Special Significance of Plankton Productivity- Review

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Review

In marine world, estuarine and coastal ecosystems are dynamic environment as these are the cradle grounds for phytoplankton growth because they receive constant supply of nutrients from rivers and other land based discharges [1]. In the nutrient stoichiometry, nitrogen (N) and phosphorous (P), commonly referred to limiting nutrients [2,3] promote the phytoplankton growth [4,5]. Besides the availability of nutrients, the physical factors such as flushing rate, salinity and turbidity also largely influence the distribution and abundance of plankton communities in the estuaries [6-8].

However, in estuarine environments, combinations of high nutrient inputs and low saline conditions intensify the biological productivity (primary and secondary) because of their preference to a variety of planktonic organisms (marine, brackish and fresh water) at low salinity. Therefore, the estuaries are always considered as biologically active zones [9,10]. Estuarine ecosystems exhibit different types of trophic relationship within planktonic community [10-12]. Plankton is a group of autotrophic and heterotrophic drifting organisms in aquatic environments that are the base of food chain in these environments. Included in this group are bacterioplankton, phytoplankton and zooplankton. The abundance and distribution of plankton communities are depend on nutrient concentrations, chemical and physical conditions of water, and the abundance of other plankton.

Their abundance varies horizontally, vertically and seasonally. In one trophic level, above the prokaryotes, these are the free-living protists, mainly formed by diatoms, dinoflagellates and protozoa, which are responsible for primary production. Protozoa, especially ciliates and flagellates, are also able to participate in the bacterial consortia, stimulating the bacterial activity and also being the link among the base and the other trophic levels. This biotic interaction occurs through the characteristics of predation, foraging and dispersal ability presented by ciliates and flagellates [13].

Traditionally, it has been hypothesized that the diatoms are the major contributors to the primary production in coastal and estuarine waters, which subsequently get transferred to fish through meso- and macrozooplankton. Conversely, recent studies on size-fractionated plankton communities have questioned this view, often linking the significance of microzooplankton as the key consumers of phytoplankton in the coastal waters [14,15] because of their higher mass-specific physiological rates. In many cases, when both the relative abundance and grazing rates of copepods and microzooplankton are compared, the growth and grazing of copepods (mesozooplankton) are inadequate compared to those of microzooplankton [16].

In marine food chain, the size structure of planktonic community mainly regulates the prey-predator interactions and the rate of biological processes [17,18]. Cell size of phytoplankton is an important factor as it changes with the environmental settings, reflecting the pathways of carbon cycling in the pelagic food chain [19,20]. In general, larger-sized phytoplankton are capable of exporting organic matter to the higher trophic levels through a short classical food chain, whereas the small-sized phytoplankton are grazed within complex microbial food webs (marine microbial loop) that favor the recycling of organic matter [21]. Many studies have confirmed that small sized phytoplankton is an important link of the plankton community. Although their relative contribution to the total community varies with the abundance of larger-sized phytoplankton [22,23].

Generally, nutrient enrichment favors the growth of larger phytoplankton while the community composition and abundance of small phytoplankton (pico and nano) are mainly controlled by microzooplankton (cilites and flagellates) grazing [24,25]. Indian coastal and estuarine waters are highly productive with

rich biodiversity of flora and fauna. As many as 25 estuarine systems along its 7500km coastline [26]. Of which those heavily influenced by the southwest monsoon (June-September) rainfall are referred to as monsoonal estuaries [27]. Interestingly in the tropics, the Bay of Bengal and Arabian Sea, this has different kinds of physical, chemical and biological characteristics features and supporting variety of flora and fauna.

Over the years, researchers have identified more than 200 diatoms and 90 species of dinoflagellates. A total of 102 species of diatoms belonging to 17 families are known along the east coast and these numbers are relatively higher along the west coast, with 148 species in 22 families [28]. Their compilation suggests that the number of pinnate diatoms in the world's oceans could range from 500 to 784 and that of centric diatoms from 865 to 999. It has been determined that more than 25% of diatom species live in Indian waters. The diversity of dinoflagellate species in the east coast estuaries is relatively small (15 species in 7 families) compared to the west coast estuaries (76 species from 10 families). The number of estimated dinoflagellate species in the marine environment varies from 1,000-2,000. Copepods are the most widely studied group of marine zooplankton.

Approximately 210 families and 2,280 genera are described, and there are more than 14,000 species throughout the world. Out of which, as many as 1,925 copepod species have been recorded in Indian waters. A total of 106 species belonging to 23 families are known from the east coast and the diversity in the west coast of India is relatively higher at 179 species from 131 families [29]. In this context, tropical ecosystems, which combined contain as much as 75% of the global biodiversity, have been neglected. Coastal waters of the tropics and subtropics possess unique and highly productive ecosystems, such as estuaries, relict lakes, salt marshes, mangrove ecosystems, seagrass meadows and coastal lagoons. The negative effects of chemical contaminants on tropical marine ecosystems are of increasing concern as human populations expand adjacent to these ecosystems. Watershed streams and ground water carry a variety of chemicals from agricultural, industrial, and domestic activities, while winds and currents transport pollutants from atmospheric and oceanic sources to these marine coastal ecosystems .The rapid ecological shifts that are occurring in the world's oceans present major challenges for researchers, managers and policy makers.

Understanding and reducing risk exposure will become increasingly important as conditions change and the likelihood of major ecological shifts increases. Actions that reduce the flow of nutrients and sediments from coastal catchments, for example, as well as those that reduce activities such as the deforestation of mangroves and the overfishing of key ecological species (e.g. herbivores), will become increasingly important as the impacts of climate change mount.

In general, marine coastal ecosystems of the tropics have to cope with the climatic vagaries of drought or flood. The plankton production also shows interesting variations during these exceptional years of drought or flood. During flood no immediate plankton production was observed due to turbidity of water but drought years show good plankton production in the estuarine systems due to remarkable hydrographic stability. The contribution of the estuarine- dependent marine fishery in the total harvest amounted to 49.02% [30-32] for all India landings. Thus phytoplankton based nature of food pyramid plays a great role in the pelagic and the coastal zone ecosystems such as estuaries, mangroves, and backwaters of the tropics.

References

1. Adams JB, Bate GC (1999) Growth and photosynthetic performance of Phragmitesaustral is in estuarine waters: a field and experimental evaluation. Aquatic Botany 64(3-4): 359-367.
2. Armstrong RA (1994) Grazing limitation and nutrient limitation in marine ecosystems: steady state solutions of an ecosystem model with multiple food chains. Limnology and Oceanography 39(3): 597-608.
3. Cermeno P, Maranon E, Rodrıguez J, Fernandez E (2005) Large-sized phytoplankton sustain higher carbon-specific photosynthesis than smaller cells in a coastal eutrophic ecosystem. Marine Ecology Progress Series 297: 51-60.
4. Chisholm SW (1992) Phytoplankton size. In: Falkowski PG, Woodhead AD (Eds.), Primary productivity and biogeochemical cycles in the sea. Plenum, New York, USA, pp. 213-236.
5. Cleorn JN (1987) Turbidity as a control on phytoplankton biomass and productivity in estuaries. Continental Shelf Research 7(11-12): 1367-1387.
6. EEA (1999) Nutrients in European Ecosystems. Environment Assessment Report No. 4. European Environment Agency, Copenhagen, Denmark.
7. Ferreira JG, Wolff WJ, Simas TC, Bricker SB (2005) Does biodiversity of estuarine phytoplankton depend on hydrology? Ecological Modeling 187(4): 513-523.
8. Fessenden L, Cowles TJ (1994) Copepod predation on phagotrophic ciliates in Oregon coastal waters. Marine Ecology Progress Series 107(1-2): 103-111.
9. Gifford DJ (1988) Impact of grazing by micro zooplankton in the northwest arm of the Halifax harbour, Nova Scotia. Marine Ecology Progress Series 47: 249-258.
10. Hilmer T, Bate GC (1990) Covariance analysis of chlorophyll distribution in the Sundays River estuary, Eastern Cape. South African Journal of Aquatic Sciences 16(1-2): 37-59.
11. Jyothibabu R, Madhu NV, Jayalakshmi KV, Balachandran, Shiyas KK, et al. (2006) Impact of fresh water influx on microzooplankton mediated food web in a tropical estuary (Cochin backwaters-India). Estuar. Coast Shelf Sci 69(3-4): 505-518.
12. Ketchum BH (1967) Phytoplankton nutrients in estuaries. In: Lau GH (Ed.), American Association for the Advancement of Science, The Horn-Shafer Company, Washington, USA, 83: 329-335.
13. Khlebovich VV (1974) The Critical Salinity of Biological Processes. Nauka, Leningrad (in Russian).
14. Krishnamurthy K, Damodara Naidu W, Santhanam R (1978) Plankton biogeography of the Indian Ocean. Internationale Revue der Gesamten Hydrobiologie 63(5): 721-726.
15. Kibirige I, Perissinotto R (2003) In situ feeding rates and grazing impact of zooplankton in a South African temporarily open estuary. Marine Biology 142(2): 357-367.

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16. Legendre L and Le Fevre J (1988) Hydrodynamic singularities as controls of recycled versus export production in oceans. In: Berger WH, Smetacek VS, Wefer G (Eds.), Productivity of the ocean: Present and past. Dahlem Konferenzen, Wiley, Chichester, England, UK.

17. Leising AW, Horner R, Pierson, J Postel J, Halsband-Lenk C, et al. (2005) The balance between micro zooplankton grazing and phytoplankton growth in a highly reductive estuarine fjord. Progress in Oceanography 67(3-4): 366-383.

18. Malone TC (1980) Algal size. In: Morris I (Ed.), The physiological ecology of phytoplankton. Blackwell Scientific, London, UK, pp. 433-465.

19. McLusky DS (1971) Ecology of Estuaries. Heinmann Educational Books, London, UK.

20. Neill M (2005) A method to determine which nutrient is limiting for plant growth in estuarine waters at any salinity. Mar Pollut Bull 50(9): 945-955.

21. Perissinotto R, Walker DR, Webb P, Wooldridge TH, Bally R et al. (2000) Relationship between zoo-and phytoplankton in a warm-temperate, semi permanently closed estuary, South Africa. Estuarine Coastal and Shelf Science 51(1): 1-11.

22. Peters EC, Gassman NJ, Firman JC, Richmond RH, Power EA et al. (1997) Ecotoxicology of tropical marine ecosystems. Environmental Toxicology and Chemistry 16: 12-40.

23. Qasim SZ (2003) Indian estuaries. Allied publication Pvt. Ltd. Heriedia Marg, Ballard estate, Mumbai, India, pp. 259.

24. Qasim SZ, Kureishy TW (1986) Biological productivity in the seas around India: present status and major threats. Proc Indian Acad Sci 64: 1-17.

25. Raimbault P, Rodier M, Taupier-Letage I (1988) Size fraction of phytoplankton in the Ligurian Sea and the Algenan Basin (Mediterranean Sea): size distribution versus total concentration. Marine Microbial Food Webs 3: 1-7.

26. Riegman R, Kuipers, BR, Noordeloos AAM, Witte HJ (1993) Size-differential control of phytoplankton and the structure of plankton communities. Netherlands Journal of Sea Research 31(3): 255-265.

27. Sautour B, Artigas F, Herbland A, Laborde P (1996) Zooplankton grazing impact in the plume of dilution of the Gironde estuary (France) prior to the spring bloom. Journal of Plankton Research 18(5): 835-853.

28. Sigee D (2005) Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment. (1st edn), John Wiley & Sons Ltd., West Sussex, Shire, UK, p. 544.

29. Tan Y, Huang L, Chen Q, Huang X (2004) Seasonal variation in zooplankton composition and grazing impact on phytoplankton standing stock in the Pearl River estuary. Continental Shelf Research 24(16): 1949-1968.

30. Tang EPY (1995) The allometry of algal growth rates. Journal of Plankton Research 17(6): 1325-1335.

31. Venkataraman K, Wafar M (2005) Coastal and marine biodiversity of India. Indian J Mar Sci 34(1): 57-75

32. Vijith V, Sundar D, Shetye SR (2009) Time-dependence of salinity in monsoonal estuaries. Estuarine Coastal and Shelf Science 85(4): 601-608.

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