

Understanding chlorophyll dynamics in aquatic ecosystems in Bay of Bengal

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The present article explores the dynamics of chlorophyll concentration in aquatic ecosystems of the Bay of Bengal, emphasising its critical role in supporting phytoplankton populations and, consequently, the health of marine environments. The study presents a chlorophyll dynamics model governed by a differential equation that incorporates intrinsic growth rates, carrying capacity and loss processes. A significant finding is the identification of a stable fixed point at $C = 1 \text{ mg/m}^3$, which represents a threshold concentration for chlorophyll. At this concentration, the system is poised for maximum fish catch, as it indicates optimal conditions for zooplankton grazing, which in turn supports higher trophic levels. Understanding this relationship is also vital for effective ecosystem management and predicting algal blooms, thereby contributing to sustainable fisheries and aquaculture practices. The implications of these findings underscore the importance of monitoring chlorophyll dynamics to maintain ecological balance and optimise fishery yields.

that this growth rate can vary significantly based on nutrient availability and environmental factors². The carrying capacity (K) of the environment further constrains growth, as it represents the maximum chlorophyll concentration that can be sustained. As chlorophyll concentration approaches this carrying capacity, the growth rate diminishes, preventing unchecked population expansion³.

In addition to growth, chlorophyll dynamics are also affected by loss processes, which include grazing by zooplankton⁴, viral lysis and degradation⁵. The maximum loss rate (d) quantifies these processes, while the half-saturation constant (a) determines the efficiency of loss mechanisms at varying chlorophyll concentrations. The interplay between growth and loss is critical for understanding phytoplankton dynamics, as it dictates the stability of chlorophyll concentrations in aquatic ecosystems⁶⁻⁸.

The chlorophyll dynamics model can be analysed through the identification of fixed points, which represent equilibrium states where the rate of change in chlorophyll concentration is zero. These fixed points are essential for understanding the long-term behaviour of the system and can indicate stable or unstable conditions. Stability analysis of these fixed points reveals how small perturbations in chlorophyll concentration can lead to significant changes in population dynamics, providing valuable insights for

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