Intermediate Disturbance Hypothesis (IDH) in Mangrove Ecosystems Revealed by Gypsum Balls: Deviations Driven by Biogenic Habitat Modification

E.M.A.N. Ekanayake*, M.P. Kumara
Department of Fisheries and Marine Science, Faculty of Fisheries & Ocean Sciences, Ocean University of Sri Lanka, Tangalle, Sri Lanka.
**ekanayakeamandhi@gmail.com*

The coexistence and interactions among mangrove prop-root-associated communities are dependent on the degree and frequency of disturbances (wave action) occurring in the underwater root environment. The intermediate Disturbance Hypothesis (IDH) suggests that species diversity peaks at intermediate levels of disturbance. Although the IDH has been applied to several ecosystems, its relevance to mangrove prop root ecosystems, characterised by tidal variations and biotic interactions that create dynamic microhabitats, remains unsubstantiated. The primary aim of this study was to experimentally test the applicability of the IDH in mangrove prop-root-associated communities, using wave action as a physical disturbance proxy, and to evaluate how spatial orientation influences disturbance diversity relationships. Gypsum balls placed horizontally and vertically across the root system were used to measure the disturbance caused by wave action. Gypsum ball dissolution was measured after a fixed 24-hour deployment period, with multiple replicate gypsum balls placed at the sampling site. Along the horizontal gradient, the highest diversity occurred in the intermediate zone ($H'=0.61\pm0.04$), compared with dense (0.31 ± 0.05) and sparse (0.22 ± 0.03) root zones. While root density modified disturbance in a way that facilitated classic competition-disturbance trade-offs based on IDH, vertical position imposed a steep physical stress gradient and biogenic habitat modification that constrain species diversity irrespective of competitive dynamics. The dominance of *Saccostrea* sp. and their role as secondary colonizers were considered as the primary drivers shaping community composition, structure, and generating enhanced habitat complexity. It demonstrated that disturbance in mangrove underwater root ecosystems was not a single, uniform process, but operated differently depending on spatial orientation, structural mediation, and proximity to sediment-driven resource pools. Overall, this research provided compelling evidence that the IDH was conditionally validated in mangrove underwater prop-root systems, functioning effectively only where disturbance interacts with habitat complexity to regulate competition, rather than where disturbance acts primarily as a physiological stressor.

Keywords: *Biotic modification, Competition, Prop root, Tidal variation.*