

# 國立臺灣海洋大學

## 海洋環境與生態研究所 專題討論

**題目：**利用多種方法於印度 Hooghly 河口探討環境對 tintinnid 多樣性及分布的影響

Environmental impact on diversity and distribution of tintinnid (Ciliata: Protozoa) along Hooghly Estuary, India: A multivariate approach

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### Abstract

The spatiotemporal distribution, diversity and biomass of the choreotrich ciliate tintinnid, the ubiquitous planktonic protist, were analysed from nine sampling sites ( $n = 252$ ) of diverse environmental stresses along the Hooghly Estuary, eastern part of India during March 2012 to August 2014. Among 32 identified tintinnid species, the agglomerated genera *Tintinnopsis* (20 sp), dominated the community (~62%) followed by *Tintinnidium* (2 sp), *Leptotintinnus* (2 sp), *Codonellopsis*, *Stenosemella*, *Helicostomella*, *Favella*, *Eutintinnus*, *Metacylis*, *Dadayiella* and *Wangiella* (each comprising single species). A wide range of seasonal variations in tintinnid abundance was recorded maximum ( $2067 \pm 893 \text{ ind. l}^{-1}$ ) for *Tintinnopsis beroidea* and minimum ( $11 \pm 4 \text{ ind. l}^{-1}$ ) for *Metacylis* sp. during the investigation period. The biomass and daily production rate of tintinnid ranged from 0.004–2.764  $\mu\text{g C l}^{-1}$  and 0.04–3.54  $\mu\text{g C l}^{-1} \text{ day}^{-1}$  respectively. An overall dominance and diversity of the small-sized tintinnid (lorica length < 76  $\mu\text{m}$ ) belonging to the genera *Tintinnopsis* sp., *Tintinnidium* sp., *Codonellopsis* sp., *Wangiella* sp., *Eutintinnus* sp., *Metacylis* sp. and *Helicostomella* sp. was pronounced, accounting ~66% of the total tintinnid abundance. K-dominance curves were plotted against log rank k, showed species dominance over the investigated sites. The multidimensional scaling (MDS) Canonical Analysis of Principal coordinates (CAP) highlighting a significantly different spatial distribution of tintinnid. Principal Component Analysis (PCA) map showed clustering of core species with chl *a* and nitrate and could be considered as the crucial factors controlling the distribution and seasonal patterns of tintinnid. Biota-environment (BIOENV) analyses also reveal that these two parameters were the significant causative factors, suggesting that tintinnid may be used as a bioindicator for discriminating water quality in this estuarine system. The study provided detailed

information of microzooplankton which enhances our understanding regarding its crucial role in marine ecosystem and complex biotic interactions for maintaining the ecological and economic stability.

### 中文摘要

本研究於 2012 年 3 月至 2014 年 8 月期間，[沿著以](#)印度東部 Hooghly 河口地區分析 9 個不同環境壓力的採樣點 ( $n = 252$ ) 中纖毛蟲 tintinnid 之時空分佈、多樣性和生物量。共鑑定 32 種 tintinnid，其中包覆雜質的 *Tintinnopsis* 屬 (20 種) 在群聚中占主導地位 (~62%)，其次是 *Tintinnidium* (2 種)、*Leprotintinnus* (2 種)、*Codonellopsis*、*Stenosemella*、*Helicostomella*、*Favella*、*Eutintinnus*、*Metacylis*、*Dadayiella* 及 *Wangiella* (每一屬含一種)。tintinnid 的豐度在不同的季節間變化極廣，調查期間記錄著 *Tintinnopsis beroidea* ( $2067 \pm 893$  ind.  $l^{-1}$ ) 呈現最大量和最少量的 *Metacylis* sp ( $11 \pm 4$  ind.  $l^{-1}$ )。tintinnid 的生物量和每日生產量各為  $0.004\text{--}2.764$   $\mu\text{g C l}^{-1}$  和  $0.04\text{--}3.54$   $\mu\text{g C l}^{-1} \text{ day}^{-1}$ 。小型 tintinnid (殼長  $< 76$   $\mu\text{m}$ ) 之主要物種及多樣性以 *Tintinnopsis* sp., *Tintinnidium* sp., *Codonellopsis* sp., *Wangiella* sp., *Eutintinnus* sp., *Metacylis* sp. 以及 *Helicostomella* sp. 為主，佔 tintinnid 總豐度約 66%。研究利用 K-優勢曲線呈現各站的優勢物種。多維標度 (MDS) 典型相關分析 (CAP) 強調 tintinnid 空間分佈的顯著差異。主成分分析 (PCA) 顯示核心物種對與 [chl a](#) [及一](#)硝酸鹽的關係，可被認為是控制 tintinnid 分佈及季節模式的關鍵因素。生物群環境 (BIOENV) 分析亦認為上述兩參數為重要的因子，表明 tintinnid 可能被作為區分該河口系統水質的生物指標。研究提供了詳細的微型浮游動物資訊增強了我們對其在海洋生態系統關鍵作用的理解及復雜的生物相互作用以維持生態和經濟的穩定。