The Relationship Between Hydrography, Trophic Conditions and Zooplankton Biomass in the Eastern Tropical Pacific

Jaime Färber-Lorda, Miguel F. Lavín, Armando Trasviña, Paola Cortés-Verdín, Marco A. Guerrero

Centro de Investigación Científica y de Educación Superior de Ensenada, Carr. Tijuana-Ensenada, Km. 107, Ensenada, B. C. México.
INTRODUCTION

• Zooplankton distribution is closely related to hydrographic fronts, which, in turn, are areas of higher productivity. It is thus expected to find favorable trophic conditions in coincidence with zooplankton concentrations (Mayzaud et al, 1985).

• Biochemical composition of phytoplankton has been used to study physiological conditions of populations. Higher protein has been associated with phytoplankton populations in the exponential growth phase.

• Phytoplankton is considered the potential food supply for zooplankton, and has been used to correlate trophic conditions with zooplankton biochemical composition and adaptations (Conover 1966; Conover 1978; Mayzaud and Conover 1976; Mayzaud and Poulet 1978; Mayzaud et al 1985; Färber-Lorda et al in Press), and is the link between primary and secondary producers.
Material and Methods

- Zooplankton samples were obtained with oblique tows from 200 to 0 m of a 333 µm Bongo net equipped with a flow-meter.
- Water was obtained with bottles at 20 m for the Gulf of Tehuantepec, and, at surface, 10% and 1% light atenuation level (LAL) for the Entrance of the Sea of Cortés, material was retained on GFF filters.
- Biochemical composition of POM was studied according to Mayzaud et al (1985) Farber-Lorda (1986) and Farber-Lorda (in Press) the same methods were utilized for the biochemical composition of krill.
Assumptions

• It is assumed that Particulate Organic Matter (POM) is a better estimate of zooplankton food supply, on the basis that, other parameters like chlorophyll constitute only a small part of their real energetic input. Phytoplankton is the main component of POM.

• In the Entrance of the Sea of Cortés:
  • POM= Protein + Carbohydrates

• In the Gulf of Tehuantepec:
  • POM= Protein+Carbohydrates+Lipids
Results in Sea of Cortés

- **Global Analysis of the results**
  - No significant difference was found in zooplankton biomass in dry weight, between day and night stations (dry weight: U=101, p=0.349), but night stations presented greater variability.

- **By Transect**
  - Surface=1, 10%=2, 1%=3

  - Multiple Regression, Y intercept was equal to zero:
    - $\text{Biomass}_{109-118} = (0.0176 \times \text{POM1}) - (0.0223 \times \text{POM2})$  n=5, $R^2=0.894$
    - $\text{Biomass}_{109-118} = (0.0145 \times \text{POM1}) - (0.0183 \times \text{POM3})$  n=5, $R^2=0.901$
Results Sea of Cortés

- *By Water Masses*

- Biomass-north \(= (0.01185 \times \text{POM1}) \text{ N=9, } R^2=0.764\)
- Biomass-north \(= (0.0226 \times \text{POM2}) \text{ N=9, } R^2=0.731\)

- Multiple linear regression relationship between biomass and POM.

- Biomass-north \(= (0.0144 \times \text{Pt1})+(0.0259 \times \text{Carbo1}) \text{ N=9, } R^2=0.794\)
- Biomass-north \(= (0.0203 \times \text{Pt2})+(0.0243 \times \text{Carbo2}) \text{ N=9, } R^2=0.733\)
- Biomass-north \(= (0.0152 \times \text{Pt1})+(0.0251 \times \text{Pt2}) \text{ N=9, } R^2=0.707\)
- Biomass-east \(= (0.0145 \times \text{POM1})-(0.0192 \times \text{POM3}) \text{ N=9, } R^2=0.619\)
  \[\text{Alpha}=0.10\]
Gulf of Tehuantepec
Results Tehuantepec

- The dominating krill species was *Euphausia lamelligera*, with 92%
- Biomass West = 37.9 - (0.226 * Protein West) \( r^2 = 0.932, \ N=5, \ P<0.05 \)
- Biomass East = 32.5 - (0.422 * Lipids East) \( r^2 = 0.983, \ N=5, \ P<0.01 \)
- Biomass East = 53.1 - (0.292 * POM East) \( r^2 = 0.692, \ N=5, \ P<0.05 \)
- Arc Sin%Krill Lipids West = 15.0 + 0.0695(Lipids West) \( r^2 = 0.947, \ N=4, \ P<0.05 \)
- Arc Sin%Krill Lipids Center = 17.9 + 0.0722(Lipids Center) \( r^2 = 0.559, \ N=9, \ P<0.05 \)
Arc sin \%Krill Lipids Center= 17.9 + 0.0722(Lipids Center)  \( r^2 = 0.559, \)  \( N = 9, \)  \( P < 0.05 \)
Leg I

ArcSin %Lipids Krill I = 17 + 0.0231(POMI)  
$R^2 = 0.725$ N=10

Leg II

POM Vs. Arc Sin. Lipids Krill (%)
Hypotheses

• Hypothesis 1: Zooplankton concentrates in frontal areas, where trophic conditions are also favorable. Yes, our Data support it.

• Hypothesis 2: Particulate Organic Matter (POM) and Zooplankton Biomass are correlated in the Area. Only in stratified waters with not very much mixing with other water masses

• Hypothesis 3: Euphausiid populations are responding to changing trophic conditions.