Zooplankton distribution in the Namibian Upwelling Region: A comparison of net catches with ADCP measurements

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Background

- High resolution measurements of zooplankton biomass: diel, seasonal and inter-annual time scales
- Net sampling – low spatio-temporal resolution
- Sample analysis time consuming
- New approaches - Optical counting, video recording, automatic identification, fisheries acoustics etc...
- Echosounder – transmit sound and “listen” to echo
- Particles reflect sound – zooplankton
- Acoustic backscatter cross-section (ABSC) = biomass
- **Considerations** – scatter varies with shape, orientation and physiology, sound absorption, calibration, frequency used, transducer, beam spreading etc...
- Good correlations: backscatter intensity vs. zooplankton biomass
Objectives

- Determine taxonomic composition
- Describe temporal zooplankton distribution through net catches and ADCP measurements
- Examine temporal variability of acoustically estimated zooplankton biomass and compare with net sampling
- Describe diel vertical migration of different zooplankton groups
Sampling & Analysis

- **RRS Discovery cruise (D356) - Sept/Oct 2010** - two hauls

- **Sampling (day/night): double**
  MOCNESS – 18 nets (333μm)

- **Stratified depth layers - (0-350)**
150 kHz VM-ADCP – ABS signal recorded: 37–350m

Biomass – size fractionation: <0.5, 0.5-1, 1-2, 2-5, >5mm

Taxonomic analysis – fractions identified: orders – counted
(Chaetognatha, Cnidaria, Amphipoda, Mysida, Polychaeta, Cladocera, Calanoida, Cyclopoida etc...)
Results & Discussion

- Stratified water column
- Different water masses
Biomass distribution

- Concentration – 2 layers

- Vertical migration
- Thermocline avoidance
Abundance composition (0-300m)

Day
- 0.5-1 mm: 46%
- 1-2 mm: 20%
- < 0.5 mm: 28%
- 2-5 mm: 6%

Night
- 0.5-1 mm: 52%
- 1-2 mm: 28%
- < 0.5 mm: 17%
- 2-5 mm: 3%

15 917 Ind. m⁻²
18 685 Ind. m⁻²
Abundance composition (0-300 m)

Day

- Malacostraca larvae: 4%
- Chaetognatha: 5%
- Fish eggs: 14%
- Siphonophora: 2%
- Other: 4%

Calanoida: 71%

Total: 16,061 Ind m⁻²

Night

- Ostracoda: 4%
- Malacostraca Larvae: 4%
- Other: 2%
- Fish eggs: 9%
- Cyclopoida: 5%

Calanoida: 74%

Total: 18,940 Ind m⁻²
Key taxa distribution

Calanoida

Cyclopoida

Abundance (Ind.1000m⁻³)

Depth (m)

- Night
- Day

Genus

Universität Bremen
Distinct diel vertical migration
ADCP vs. net zooplankton

Total Biomass

\[ y = 3 \times 10^x + 5.3975 \]
\[ R^2 = 0.29307 \]

Daytime

- \( p > 0.05 \)
- Slightly higher \( r^2 \)

0.5-1 mm

\[ y = 1 \times 10^x - 4.5043 \]
\[ R^2 = 0.4399 \]

1-2 mm

\[ y = 1 \times 10^x - 1.3445 \]
\[ R^2 = 0.41987 \]
ADCP vs. net zooplankton

**Total biomass**

\[ y = -8 \times 10^9 x + 32,759 \]

\[ R^2 = 0.73114 \]

- Night-time
- Negative correlation
- Measurement depth mismatch

**<0.5mm**

\[ y = -4 \times 10^8 x + 1,4555 \]

\[ R^2 = 0.82654 \]

**0.5-1 mm**

\[ y = -4 \times 10^9 x + 14,679 \]

\[ R^2 = 0.60187 \]
Conclusions

- Mesozooplankton displayed bimodal vertical distribution
- DVM responsible for bimodal distribution
- Mesozooplankton tend to avoid the thermocline and oxygen minimum zone
- Active migrants, 0.5-2 mm, mostly calanoida
- Both methods show clear DVM pattern
- Calanoida account for close to 40% backscatter
With Thanks!
In addition....
Introduction

- Zooplankton play a key role in pelagic food web
- Transfer organic material and energy
- Important food source for larval/juvenile fish
- Grazing determines the amount/composition of the vertical particle flux
- Predators of fish larvae – influence recruitment
- Potential significant application
- Limited history of application: relative newness / complexity
- Data reduction and analysis complex
- ADCPs - potential to provide biological data
- Vertical and temporal resolution excellent
- Provides a non-invasive data collection and near real time data
- AB intensity used as estimate of biomass
Abundance distribution

Night

Abundance (Ind.1000 m^{-3})

Depth (m)

- < 0.5 mm
- 0.5-1 mm
- 1-2 mm
- 2-5 mm

(0, 50000, 100000, 150000, 200000)
Key taxa distribution

- Inadequate net sampling
- Error in sieving - morphology
Acoustic backscatter distribution

Night

Relative ABSC (m² m⁻³)

Depth (m)

0E+00 1E-08 2E-08 3E-08 4E-08 5E-08 6E-08 7E-08
ADCP vs. Krill biomass

Nematoscelis megalops - Dawn

- Weak correlations
- Different migratory behaviour

Contribution variable – time of day

N. Megalops – Dusk 2

- $y = 4E+08x + 3,6208$
- $R^2 = 0,39914$

- $y = 6E+08x + 11,37$
- $R^2 = 0,4575$
Biomass distribution

Total Biomass (mg 1000 m⁻³)

Depth (m)

night
day
Outlook

- Quantify acoustic biomass
- Appropriate frequency
- More transect studies
- Inshore-offshore zones
- Seasonality
- Mesoscale events
ADCP vs. Krill biomass

N. Megalops – Dusk 1

\[ y = -6E+06x + 16,554 \]

\[ R^2 = 0,09414 \]
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