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Project: “Integrated study of coastal upwelling off central Peru”
**INTRODUCTION**

Messié and Chavez, 2015

Mann & Lazier, 2006
Microphytoplankton (20 - 300 µm)
Nanophytoplankton (2 – 20 µm)
Trade winds weaken, supressing the upwelling
**STUDY AREA**

- **Sampling period:** 2013-2017
- **Sampling frequency:** Bimonthly
- **Coverage:** Up to 50 nm from the coast
OBJECTIVES

- Characterize the nano and microphytoplankton community structure in a gradient in shore – off shore in front of Callao (12° S) in space and time.

- Evaluate the influence of environmental parameters in the composition and distribution of phytoplankton, identifying possible habitat preferences by key species.

- Identify possible phytoplankton assemblages or key species of a transition zone.
✓ Sampling with oceanographic rosette at 10 m depth and/or in water column up to 75 m.

✓ Quantitative analysis (Utermöhl)

✓ Shannon index diversity

✓ **Statistical analysis**
  - Olmstead and Tukey diagram
  - Spatial and temporal classification and ordination

(PRIMER 6 and R)
Vertical distribution

Diatoms

Dinoflagellates

Coccolithophorids

Phytoplankton

1702 1704

1702 1704
Obtaining phytoplankton species hierarchy

Olmstead y Tukey diagram of micro and nanophytoplankton species off Callao (2013-2017)

- 189 species were obtained by Utermöhl method.
- They were classified in diagram to perform multivariate analysis then.
- 61 dominant species were determined.
Spatial Clustering and Canonical correspondence analysis (CCA) showing the distribution of dominant phytoplankton species in relation to environmental variables.
Temporal Clustering and Canonical correspondence analysis (CCA) showing the occurrence of dominant phytoplankton species in relation to environmental variables.
4 main phytoplankton assemblages were obtained
Improving coccolithophorids sampling!
Upwelling

Low pH/high CO2

Coccolithophorids

Estaciones

<table>
<thead>
<tr>
<th>st1</th>
<th>st2</th>
<th>st3</th>
<th>st4</th>
<th>st5</th>
<th>st6</th>
<th>st7</th>
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</thead>
<tbody>
<tr>
<td>stock total (x10³ cell/L)</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

mean abundance

X \(-43.80 \times 10³\) cell/L

Coastal area

Composition and abundance of coccolithophorids

- **Emiliania huxleyi**
- **Gephyrocapsa oceanica**
- **Florisphaera profunda**
- **Helicosphaera carteri**
- **Ophiaster spp.**

**Otros:**
- Acanthoica quatrospina
- Anoplosolenia brasiliensis
- Calciosolenia sp.
- Calciopappus rigidus
- Gaardelia corolla
- Michaelsarsia adriaticus
- Pappomonas sp. Type 3
- Polycrater sp.
- Reticulofenestra parvula
- Syracosphaera anthos
- Syracosphaera prolongata
- Syracosphaera molischii
CONCLUSIONS

- There was a gradient in shore-off shore in all years, except in 2015 due warmer EN event conditions.

- There is a variable transition zone at 30 nm that is favourable for dinoflagellates and coccolithophorids development.

- Seasonal and interannual oceanographic influence (annual cycle of phytoplankton and ENSO signal) is reflected in the high variability of abundances and contributions of nano and microphytoplankton.

- Ecological preferences were determined for *D. pumila*, *Nitzschia sp*, *O. hidroideus*, *L. undulatum* and *P. micans*.
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