THE ADCP-BACKSCATTER AND THE USE OF IMAGE ANALYSIS (ZOOIMAGE) FOR DISCRIMINATING DIEL VERTICAL MIGRATING ZOOPLANKTON

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Humboldt Current System and fisheries production

Studies oriented to determine how variations in upwelling off central Chile affect the life history of small pelagic and some demersal fishes, benthic crustaceans.

Main objective species:

Anchoveta …*Engraulis ringens*

Sardines: *Sardinops sagax, Clupea bentincki*

Common hake: *Merlucius gayi*

Langostino… *Pleuroncodes monodon*

Processes affecting planktonic stages :

- Transport processes in and out of bays, on the continental shelf.
- Reproductive timing and cycles of of production, upwelling
- Ontogenetic changes in vertical and horizontal distribution
- Seasonal variations in egg quality, growth rates, grazing, etc.

But..what do we know about the rest of the mesozooplankton community that co-occr with the eggs and larvae of dominant fish?

Studies on mesozooplankton has increased considerably during the last decade:

Copepods
Gelatinuos zooplankton
Euphausiids
Meroplankton

Current available information :

Distribution
Changes in abundance in different time scales,
Reproduction, growth rates, mortality rates
Grazing

Role in the food web: prim. prod consumption, export of carbon to deeper layers via fecal pellets, particles sinking, etc.
... **biogeochemical cycles**

But,

still scarce information exists on their vertical distribution,
Ontogenetic and environmental factors that affect their depths of residence,
the time spent in different layers,
the role of hydrographic features such as the Oxygen Minimum zone, the upwelling circulation, etc.

Objective:

Assess the small scale variations in vertical distribution of larger sized *zooplankton and the potential role of changes in the local hydrodynamics in the determination of these vertical changes in zooplankton distribution*

Why that objective?

Information vertical distribution of mesozooplankton may be relevant to understand fluctuations in…

Biogeochemical cycles:

- i.e. Carbon flux between layers
- i.e. Identify main zooplankton groups responsible for variations in fluxes in different depths
. i.e. time scale (hours, days, weeks, etc) over which our flux estimations are valid, etc

Fisheries :

Some zooplankton groups…

- the early life stages are food for larvae, juvenile and adult fishes
- the adult stages have been reported as *major predators of anchoveta eggs and larvae.*
- zooplankton might *compete for food with fish larvae* in times of low food abundance
- constitute the most *important food source for fishes* that prey on anchoveta

METHODS

Area - date

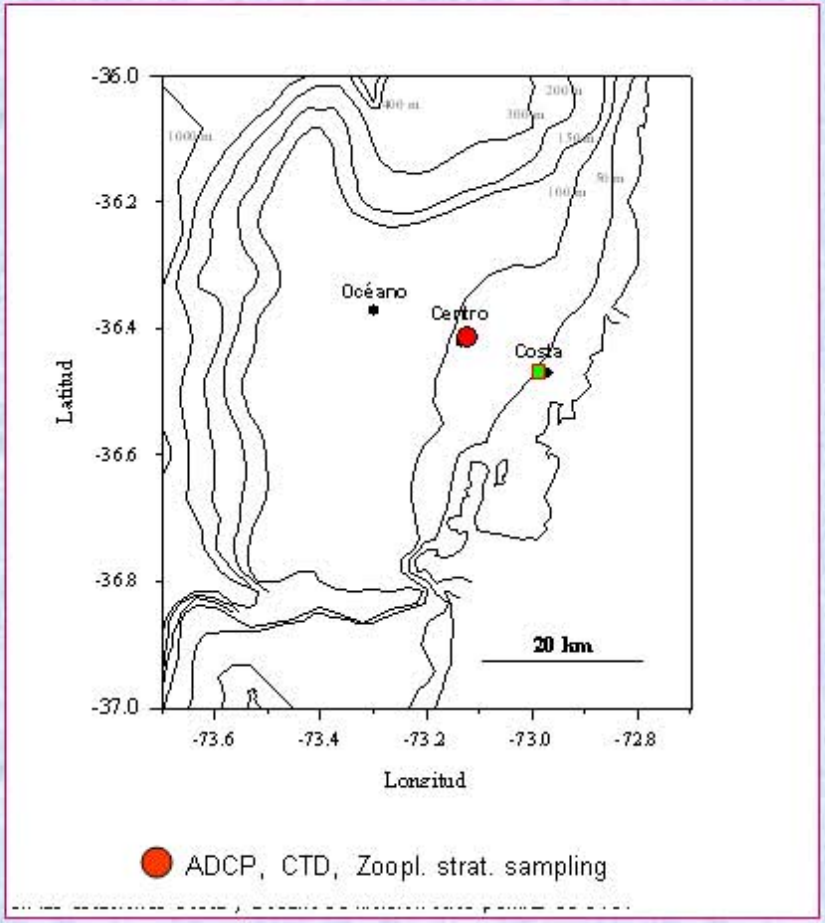
Continental shelf off Concepcion

Summer (January) and winter (August), 2005.

1) Deployments:

- ADCP (RDI 300 KHz, 100 m bottom, every 30 min, 28 d)
- thermistor chain (AanderaaTR-7) every 10 m

2) Cruises: 7 days each season



A.- Transect:

continuous back and forth repeated sampling (36 h) of a 20 km transect perpendicular to the coast, twice during each season, CTD casts and zooplankton sampling in three points along the transect

B.- **Yo-Yo station** (24 h, twice per cruise):

- CTD casts every 3 hours
- Zooplankton stratified sampling every 3 hours
  (1m^2 mouth Tucker trawl, 300 um, flowmeter)
  (5 strata: 0-15, 15-30, 30-45, 45-60, 60-80 m).
- ADCP (every 30 min)

PRELIMINARY ANALYSES

* **ADCP data** : u, v components, Backscatter

Previous studies have used backscatter for:

- Changes in zooplankton vertical distribution in different time scales
- Study association vertical distribution with mesoscale processes
- Study duration of vertical migration or residence times in certain depths

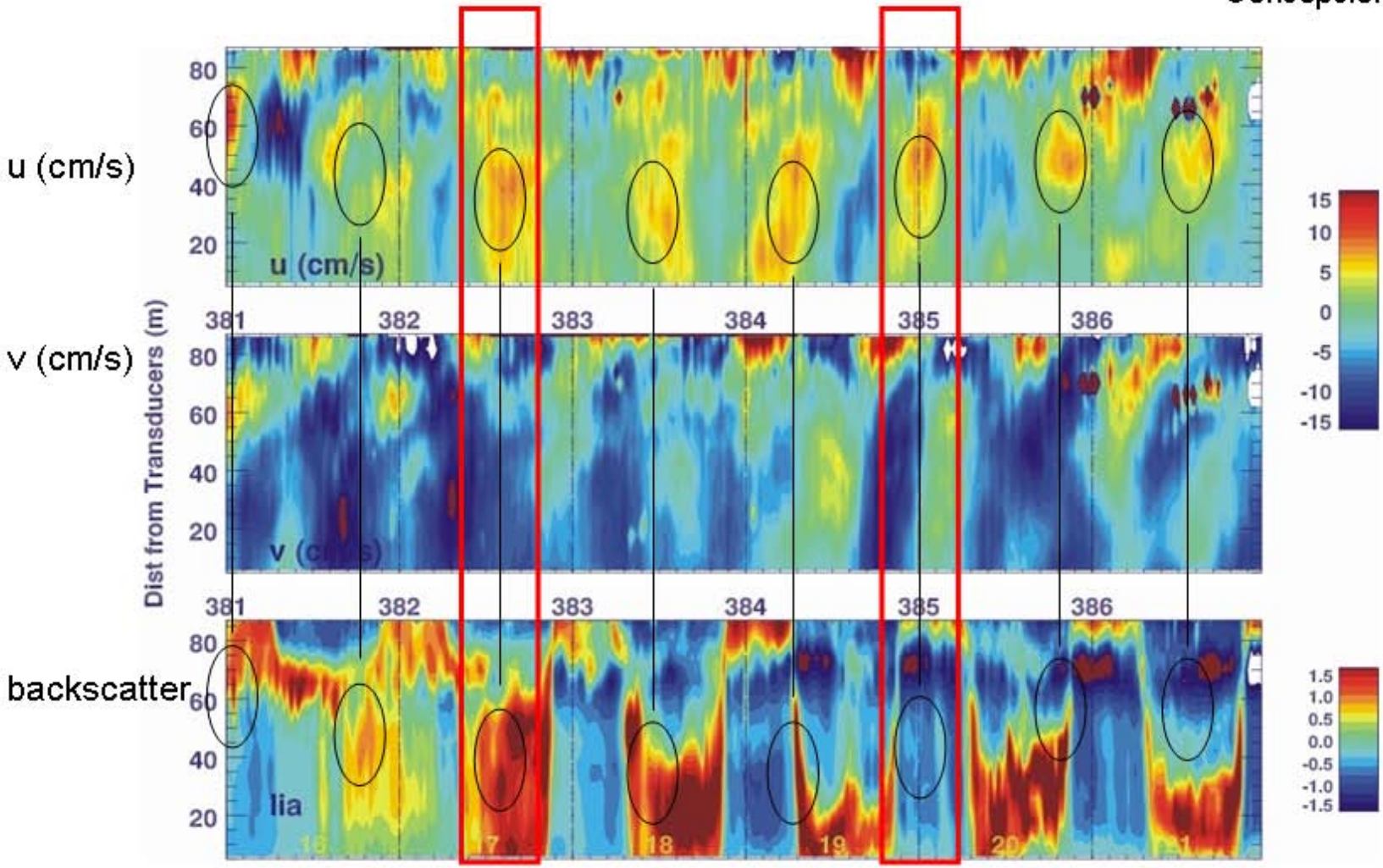
* **Zooplankton stratified samples**:

- Image analyses (ZOOIMAGE): (scanning of samples, build a training set, etc)
  - Major zooplankton groups analyses
  - Zooplankton size structure in samples
- Standard zooplankton sorting, identification and body size measurement of dominant large-size zooplankton group

CURRENTS AND BACKSCATTER COUPLING

January 16-21, 2005,

Concepcion, Chile



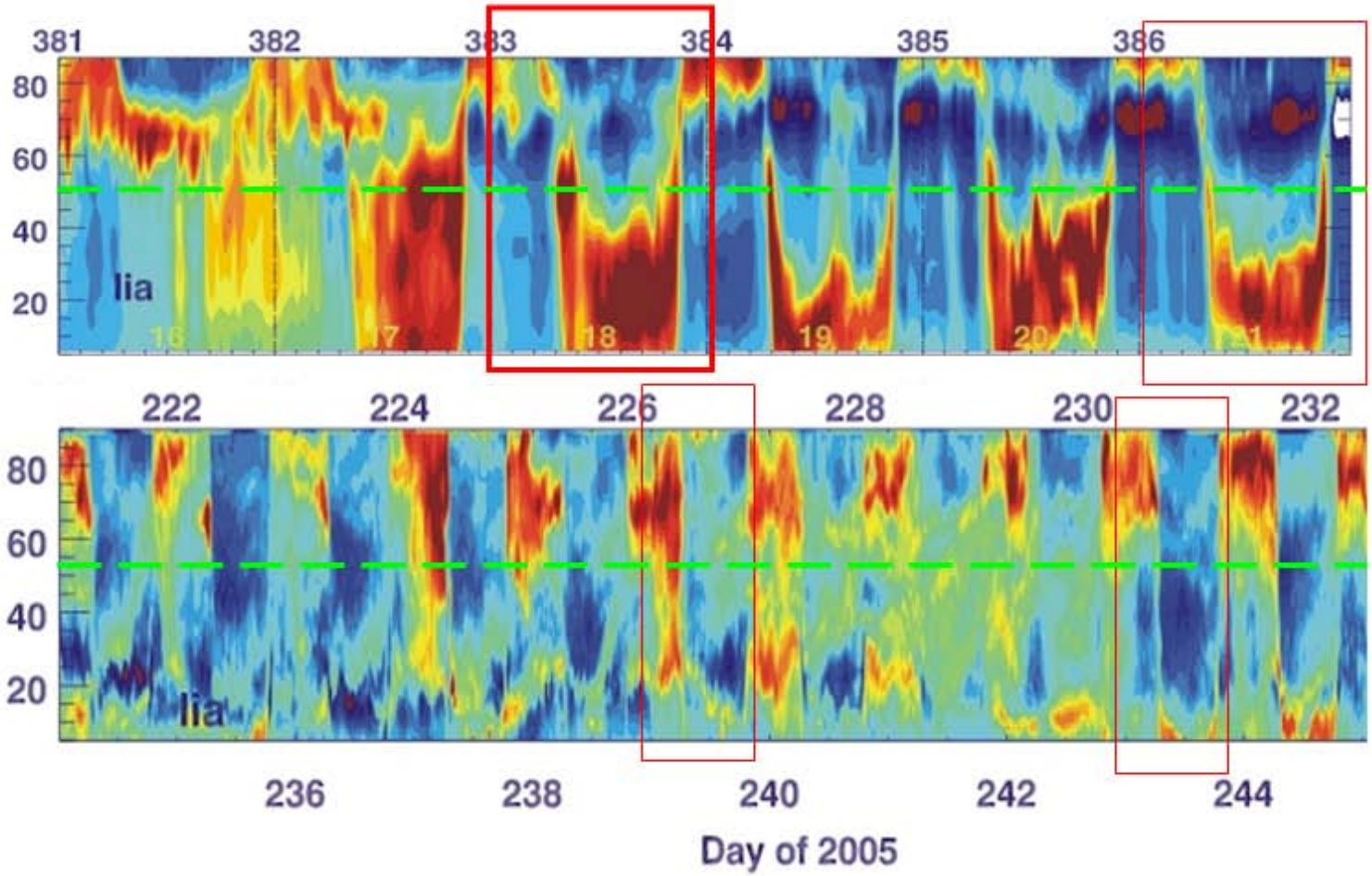
Bacscatter periodic variations seem out of phase with internal wave propagation.

Backscatter is not a result of passively drifting particles associated with any particular flow…

… instead they show a diel pattern of change in vertical distribution..

BACKSCATTER

What zooplankters produces such changes in vertical distribution of the backscatter sign?



SUMMER

Jan 16-21 2005

(6 days)

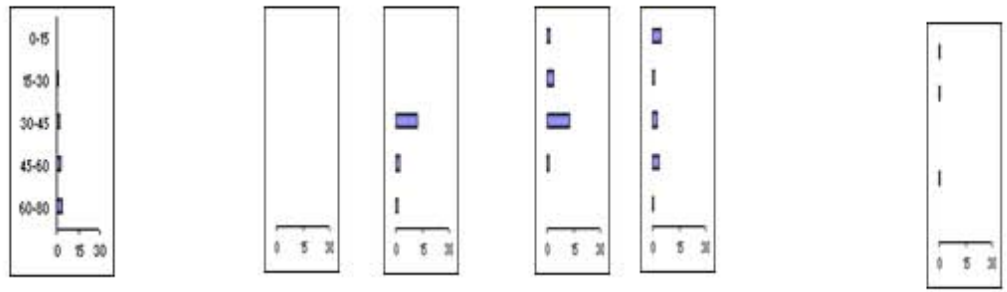
WINTER

Aug 8-20 2005

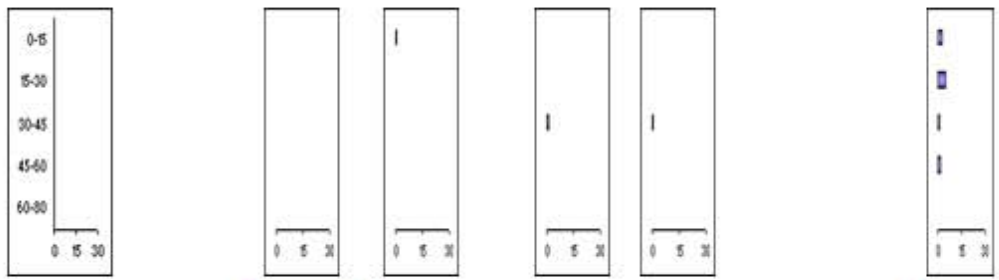
(12 days)

SUMMER

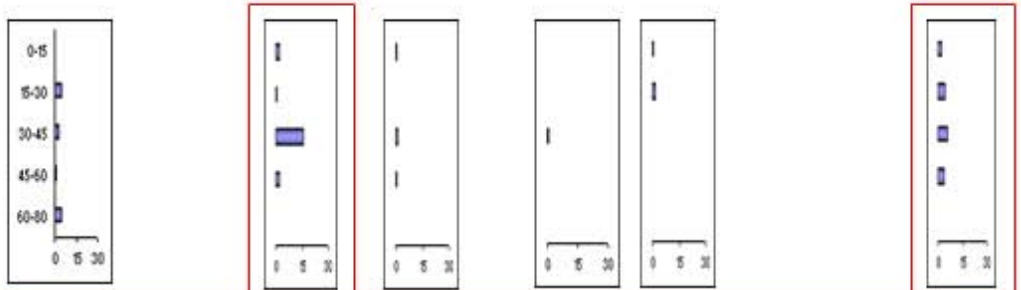
ZOOIMAGE DENSITY ESTIMATES



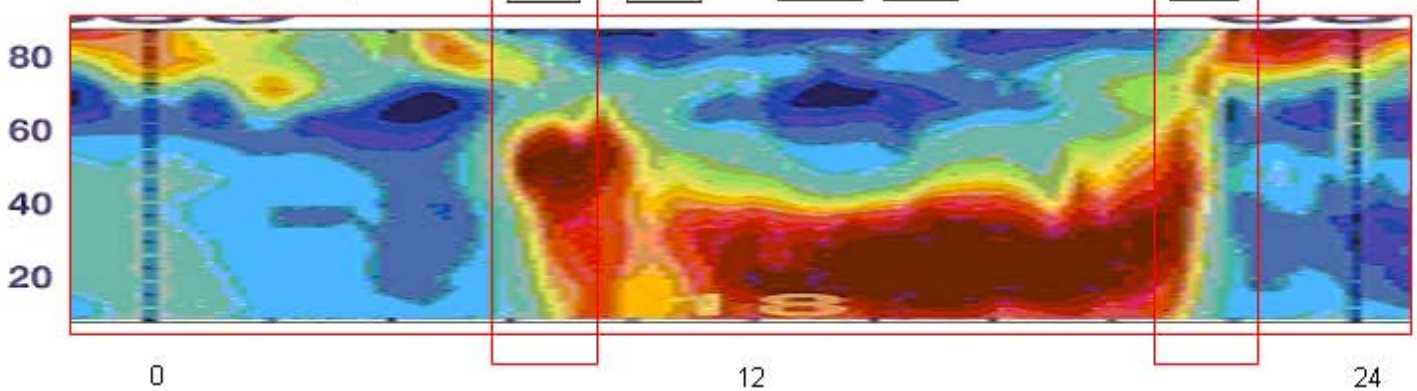
Siphonophores



Chaetognaths



Euphausiids
(Adults)



Backscatter

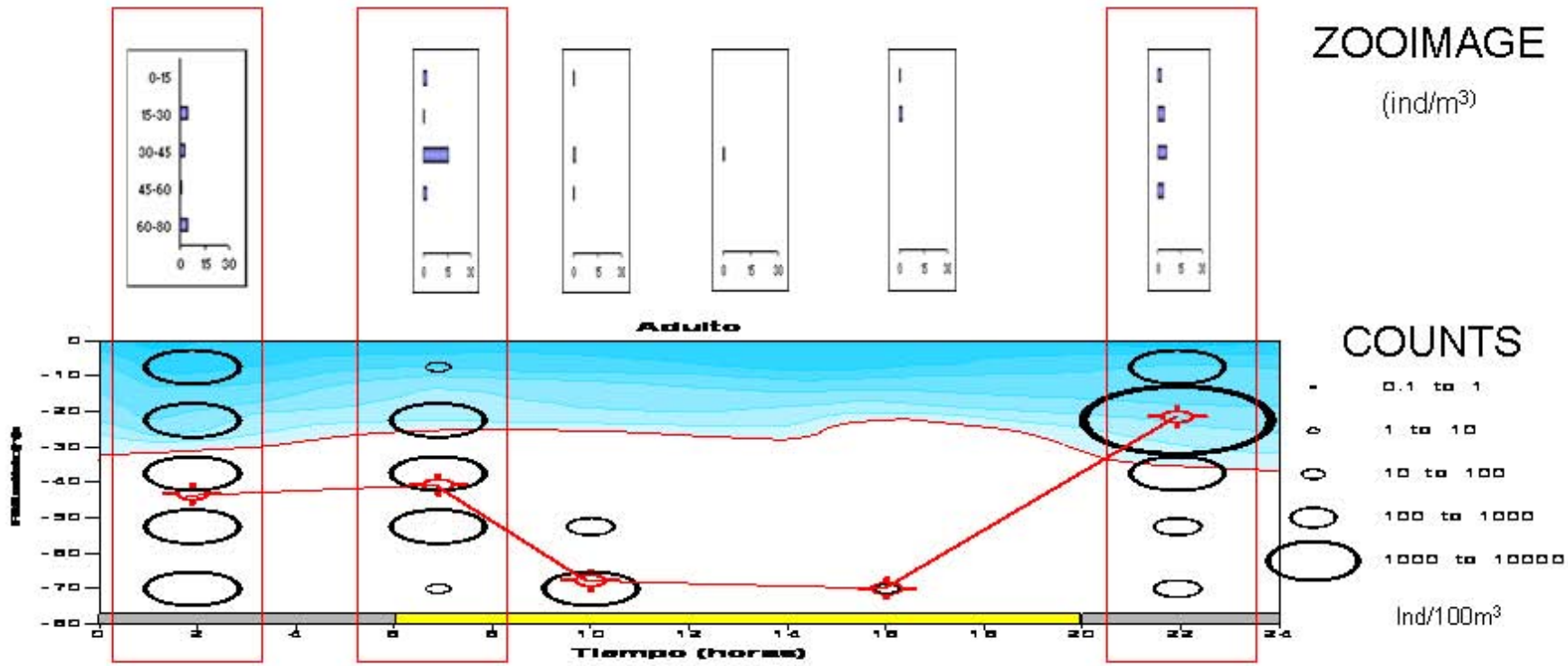
January 18, 2005

SUMMER

January 18, 2005

DENSITY ESTIMATES : ZOOIMAGE VS COUNTS

ADULT *EUPHAUSIA MUCRONATA*



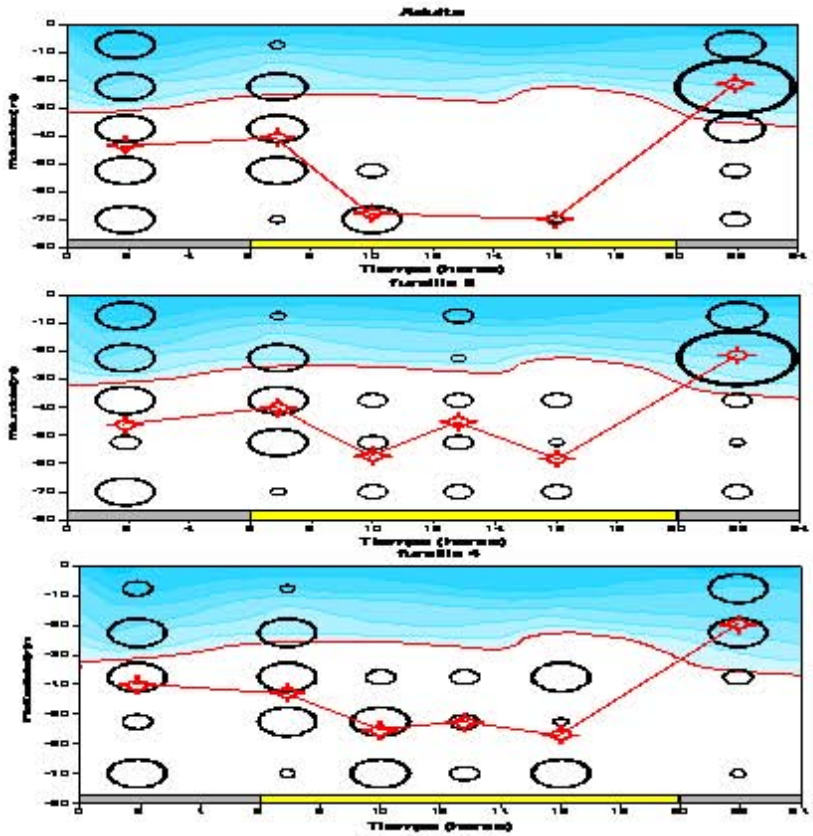
ZOOIMAGE density estimates follow "real" density (counts) when organisms are abundant …

(under low abundance… larger fractions or the entire samples are to be analyzed)…

SUMMER : WHAT IS ADCP BACKSCATTER DETECTING?

January 18, 2005

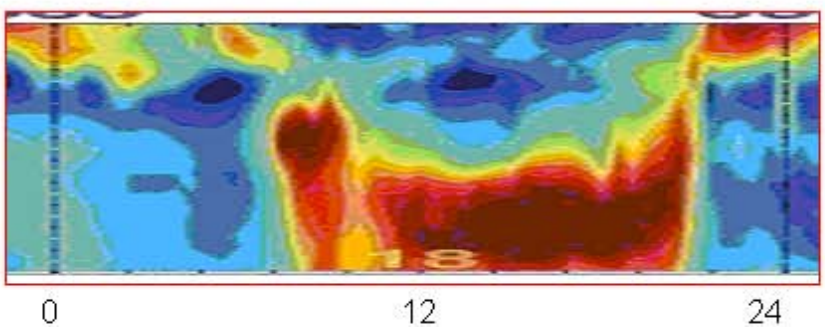
Counts

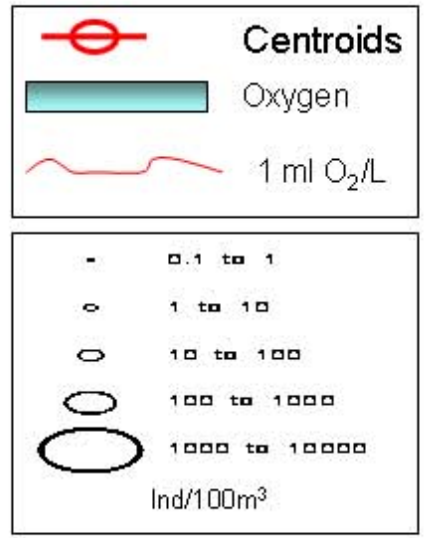


ADULT EUPHAUSIIDS

FURCILIA 5

FURCILIA 4





Bacscatter signal is detecting:

A.- advanced furcilia and adult euphausiids

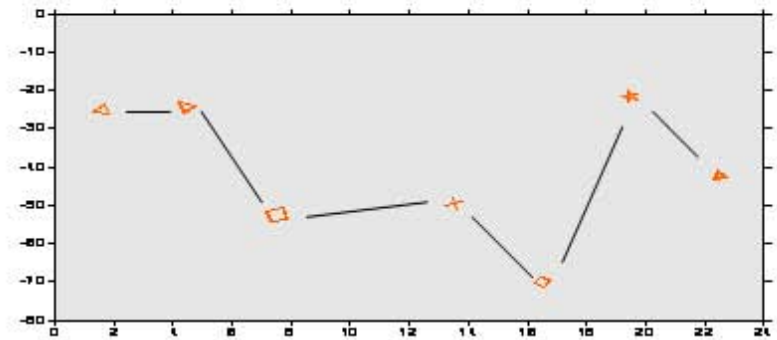
B.- Vertical migration of euphausiids between OMZ and upper layer

WINTER

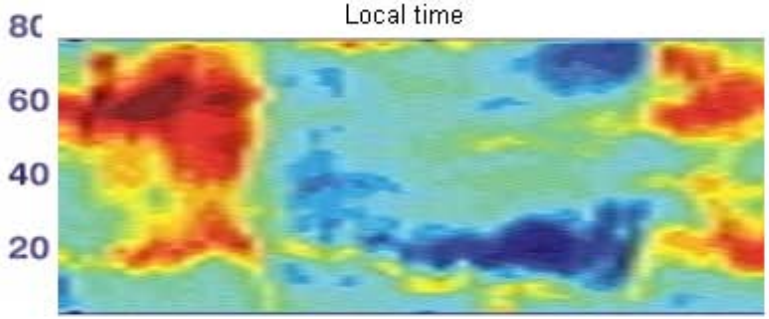
August 18, 2005

ZOOIMAGE

Centroids of size fraction > 6 mm

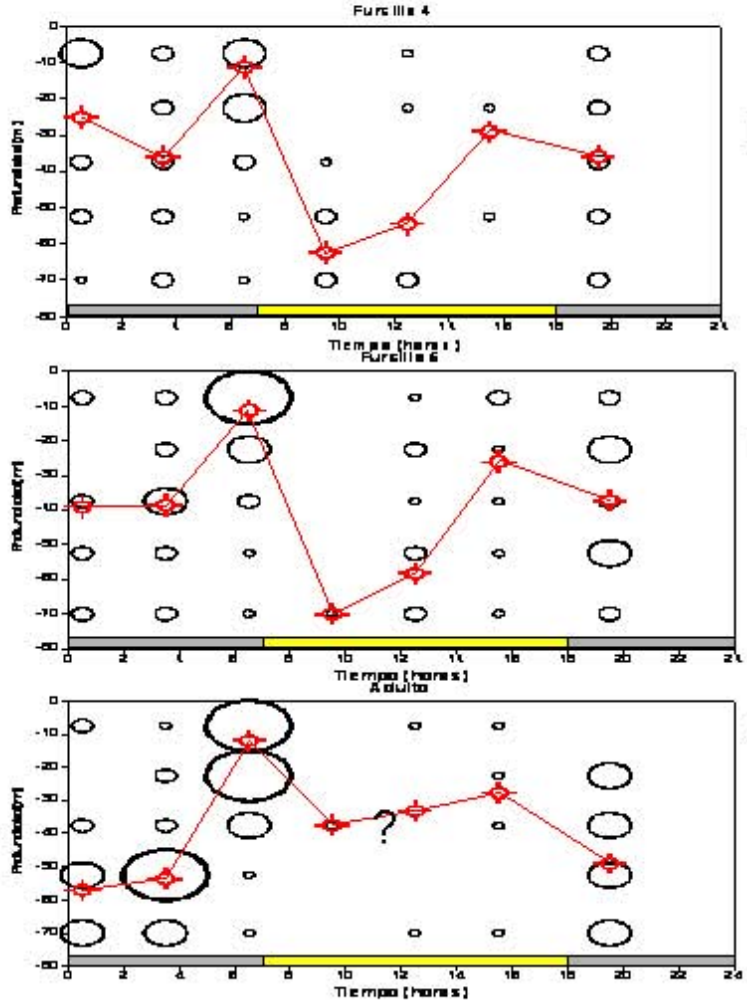


Local time



BACKSCATTER

COUNTS



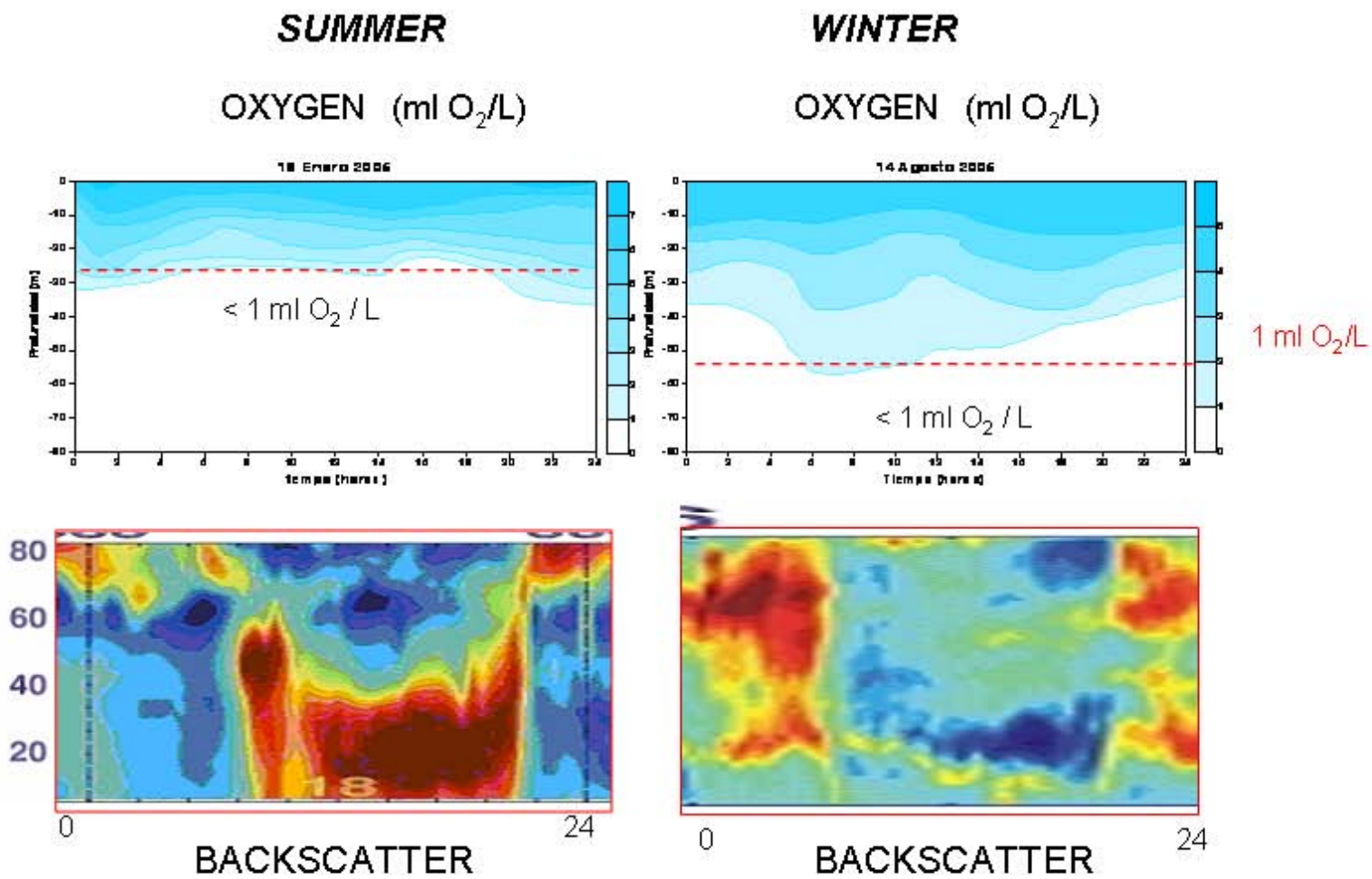
Furcilia 4

Furcilia 5

Adults

In winter, evidence of diel migrations are not too clear in backscatter because during day-time hours signal is too weak…

…..where did the large zooplankton go? …Dispersed? …Deepened?



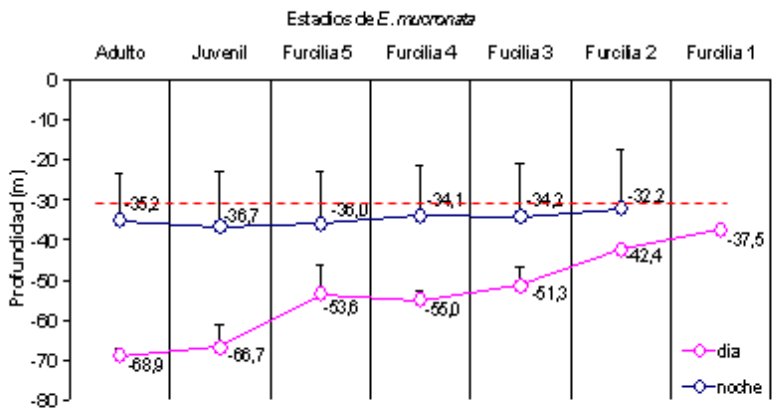
There was a deepening in the Oxygen minimum layer of about 20-25 m from summer to winter.

In summer, most large zooplankton during the day time were at mid water in the oxygen minimum layer.

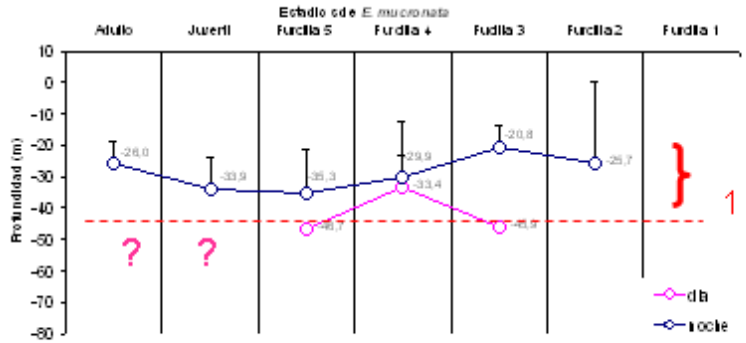
In winter, when oxygen minimum layer was deeper, larger zooplankton were detected only at night.

Day and **Night** depth of different developmental stages

SUMMER



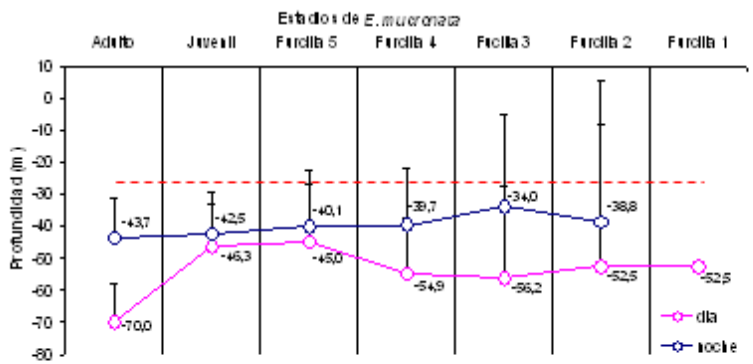
WINTER

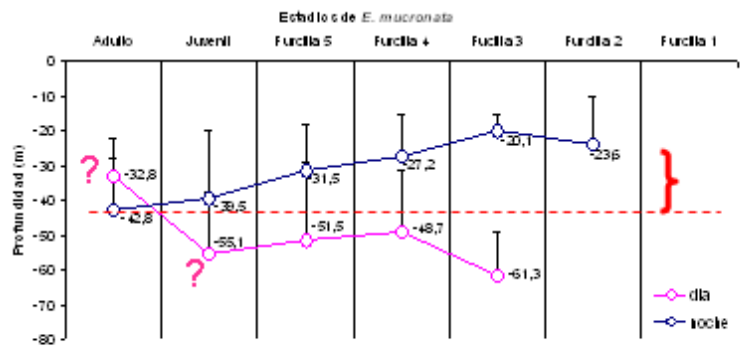


Night

Day

1 ml O_2/L





1 ml O_2/L

Ontogenetic changes in vertical distribution and seasonal variations in depth of residence, probably associated with variations in OMZ

SUMMARY:

We observed....

- u and v velocity components showed strong periodic fluctuations in association with sea breeze diel cycle, tides and internal wave propagations.

- Changes in vertical distribution of zooplankton biomass in diel, intra-seasonal and inter-seasonal time scales.

- Variations in backscatter signal apparently were not in phase with the periodic fluctuations observed in u and v current components.

- In conjuntion with standard stratified zooplankton sampling and image analyses, we determined that the main zooplankton group responsible for changes in vertical distribution of biomass: euphausiids (late furcilias, juveniles and adults)

- Ontogenetic changes in vertical distribution and also seasonal changes in day and night residence layers was determined for most euphausiid stages

- Depths of residence by migrant zooplankton were modified between summer and winter according to changes in hydrographic characteristics (upwelling and the oxygen minimum layer).

Thanks for listening…

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