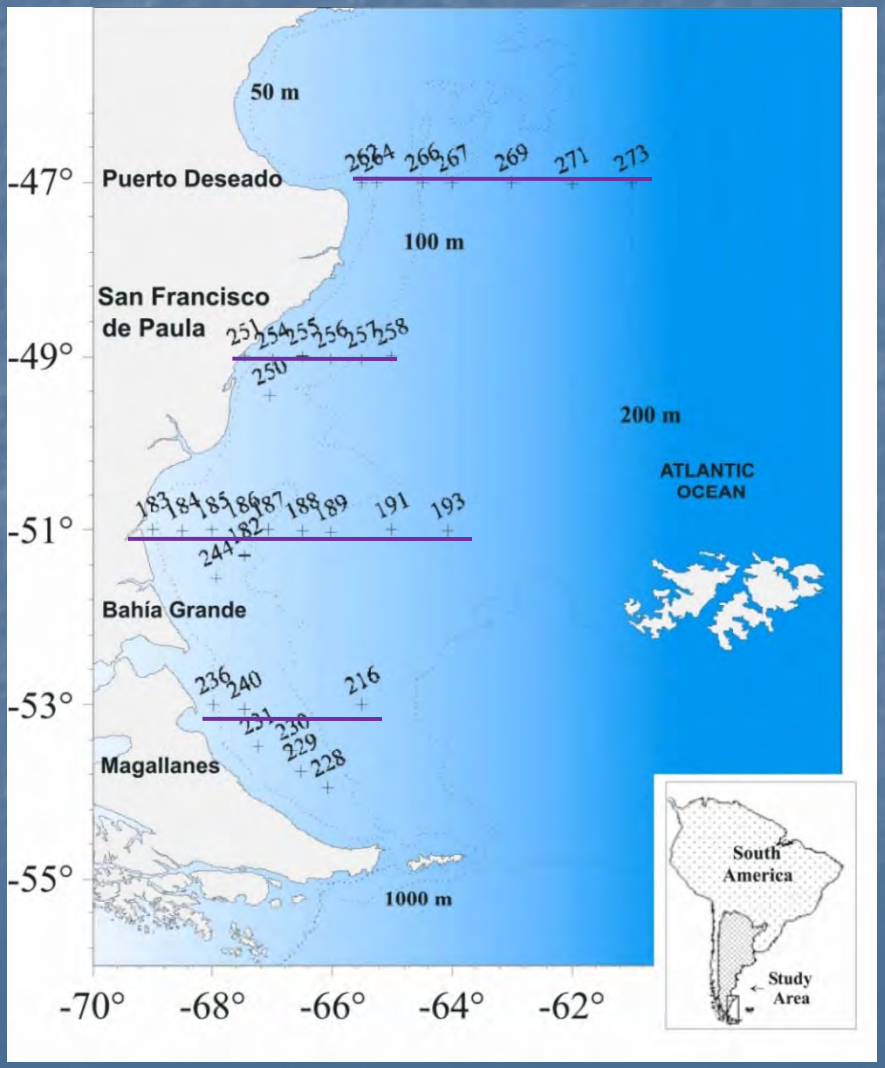
"Seasonal variability of feeding and reproductive activity of the copepods *Drepanopus forcipatus* and *Calanus australis* in the southern Patagonian shelf: post-bloom *versus* early-bloom conditions"

ANTACLI Julieta
SABATINI Marina
AKSELMAN Rut
HERNÁNDEZ Daniel

STUDY AREA
SOUTHERN PATAGONIAN SHELF

SPS



❖**Broad shelf region in the southwestern Atlantic Ocean (~47°- 55°S)**

❖ **This is a highly productive ecosystem, hosting one of the major fishing areas in the Argentine sea**

MESOZOOPLANKTON

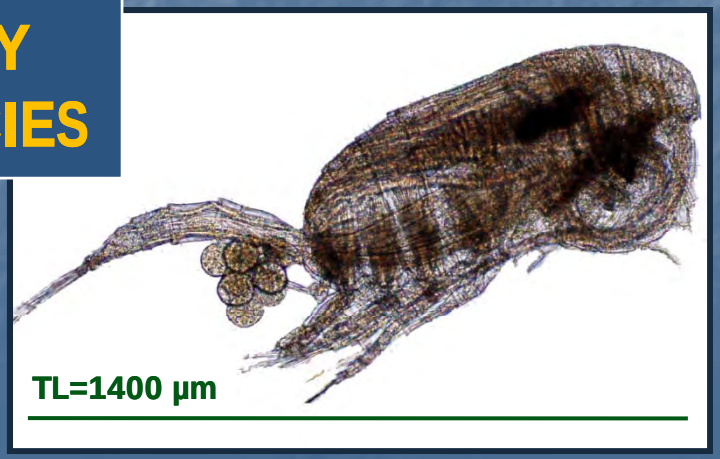
❖ **Zooplankton occupies an important position in the SPS ecosystem, since most of resources are zooplanktivores**

❖**During late summer (March-April), mesozooplankton community is dominated by three copepods species:**

Calanus australis
(Fam. Calanidae)

KEY SPECIES

Drepanopus forcipatus
(Fam. Clausocalanidae)



Oithona helgolandica
(*sensu* Ramírez 1966)
(Fam. Oithonidae)

MESOZOOPLANKTON

❖*C. australis* **and** *D. forcipatus* **together constitute most of biomass**

❖*C. australis* **and** *D. forcipatus* **have different reproductive strategies**

Calanus australis — **FREE-SPAWNING**

Drepanopus forcipatus — **EGG CARRYING**

PLANKTON COMMUNITIES < 200 µm

During late summer, after the spring bloom,

larger nanoplankton and microplankton abundance diminishes

and food availability in the size fraction

mainly grazed by copepods (>10 µm) is low

QUESTIONS	HYPOTHESES
❖ *Are both copepods trophically and reproductively active …? To what extent?*	❖**Optimal food-size low abundance determines the ending or decrease of feeding and reproductive activity**
❖ *What are they feeding on?*	❖**Copepods feed on co-occurring resources**
❖ *Are there differences between both copepods' activities at high food concentrations?*	❖**During bloom conditions, both copepods are opportunistic and increase their feeding and reproduction**

MAIN OBJECTIVES

To analyze the feeding and reproductive activity of both copepods species

two contrasting food scenarios

Post-bloom condition
Late summer
Low food concentration

Bloom condition
Early spring
High food concentration

METHODS

1) FEEDING ACTIVITY INDEX

$$\overline{FI_k} = P_k \times \overline{Lpel_{Sk}}$$

$$Standardization = \frac{Pellet\ L}{Prosome\ L}$$

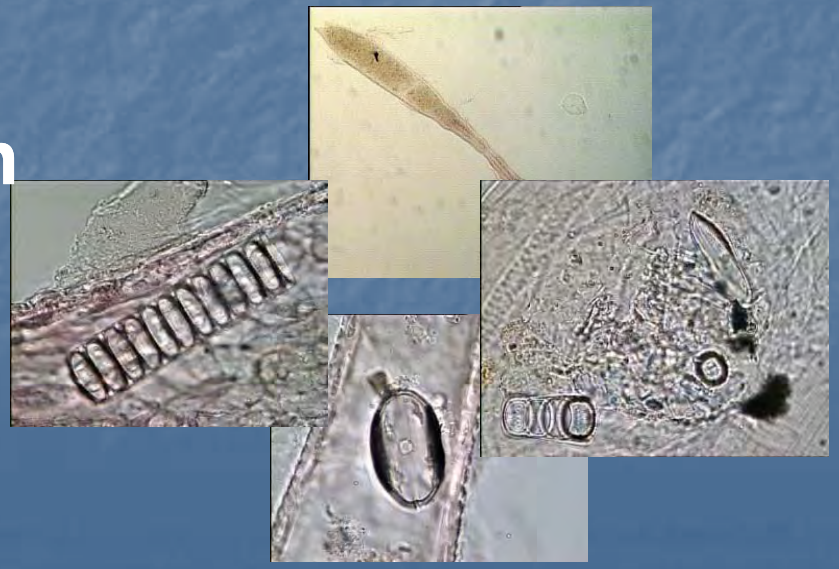
-P_k: Feeding copepods % : HOW MANY COPEPODS ARE FEEDING?

-Lpel: Food-pellet length : HOW MUCH ARE THEY CONSUMING?

2) DIET

Gut contents inspection

(Light microscopy 1000x)



METHODS

3) REPRODUCTIVE ACTIVITY

Macroscopic determination of gonad stages
(after Niehöff 2003, 2007; Niehöff & Runge 2003)

↓

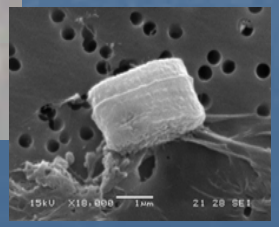
Percentage of mature females

4) PLANKTONIC COMMUNITIES COMPOSITION

Trophic availability for copepods

- *Diatoms*
- *Dinoflagellates*
- *Ciliates*
- *Criptophytes*
- *Crisophytes , etc*

Niskin bottles
Glutaraldehyde 25%
Inverted microscope 200x, 1000x



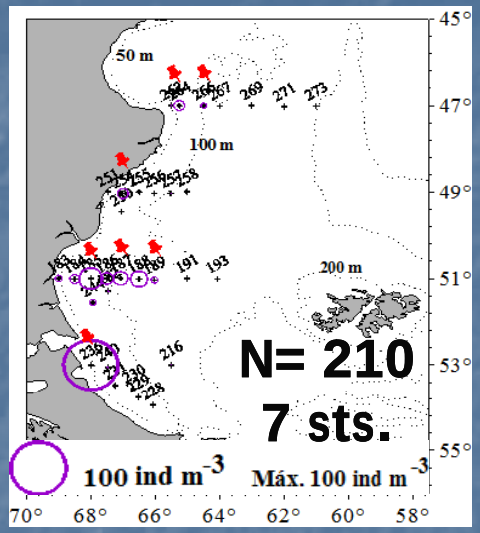
LATE SUMMER 2004

POST BLOOM CONDITIONS

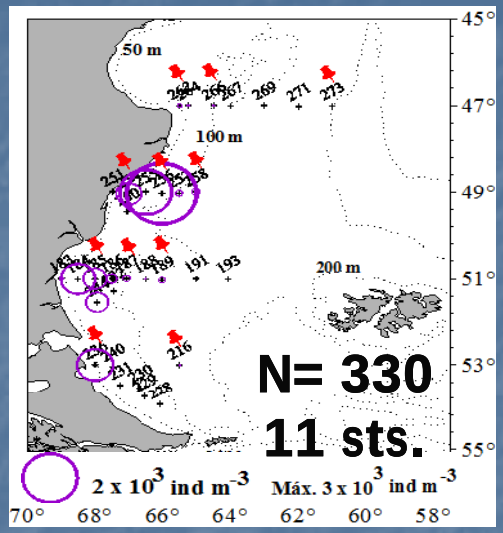
R.V. "E.L.Holmberg"
March-April, 2004
EH-03/04 INIDEP cruise

LATE SUMMER 2004

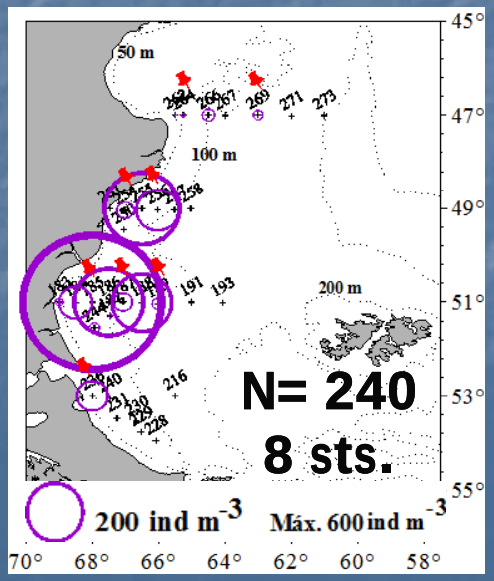
C. australis ♀



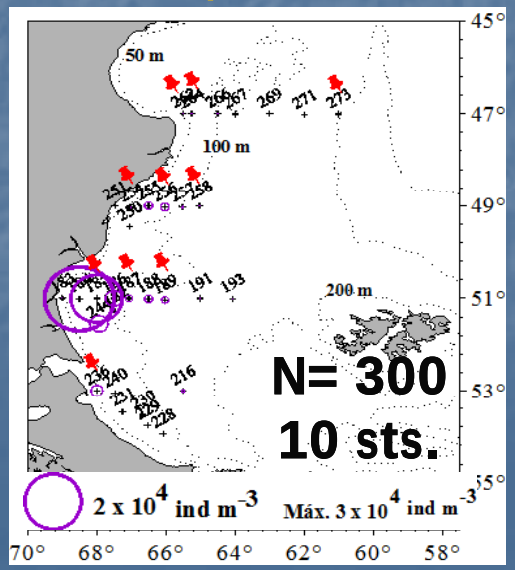
D. forcipatus ♀



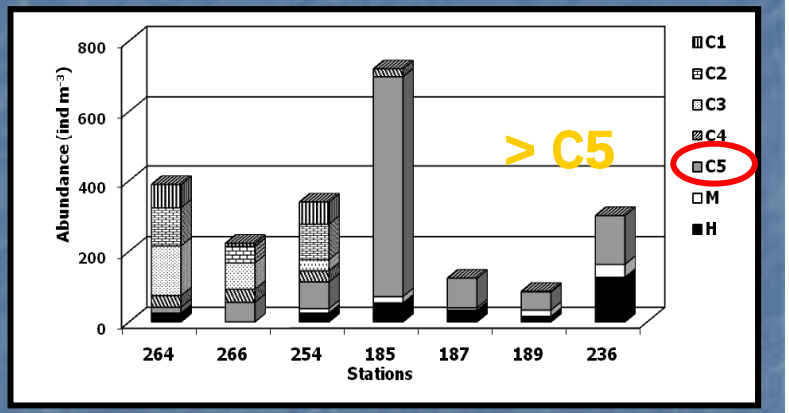
C. australis **C5**



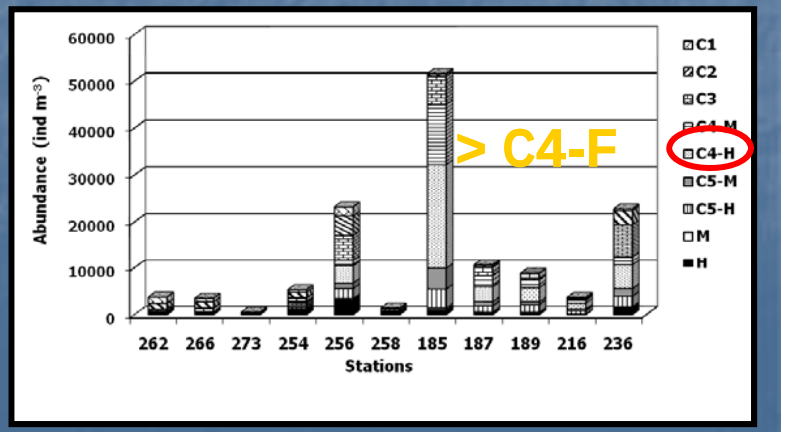
D. forcipatus **C4-F**



Calanus australis



Drepanopus forcipatus

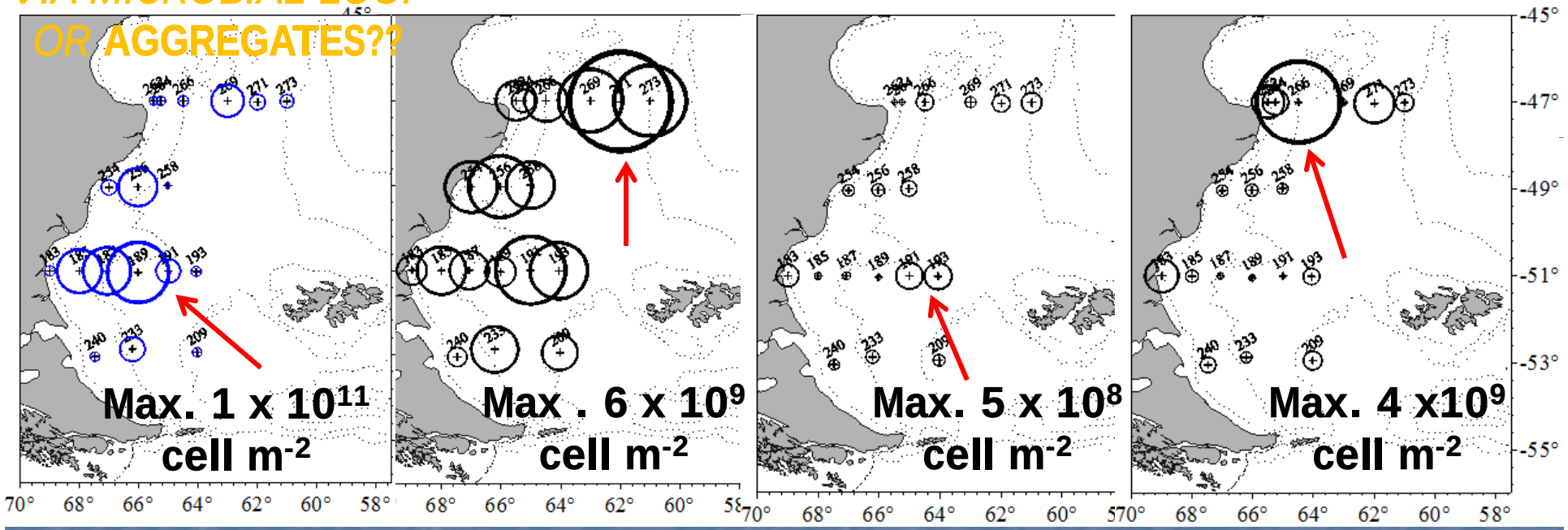


PLANKTONIC COMMUNITIES < 200 µm

2-5 µm 5-10 µm 10-20 µm 20-200 µm

INEFICIENT FEEDING VIA MICROBIAL LOOP OR AGGREGATES??

OPTIMAL FOOD-SIZE 10-14 µM



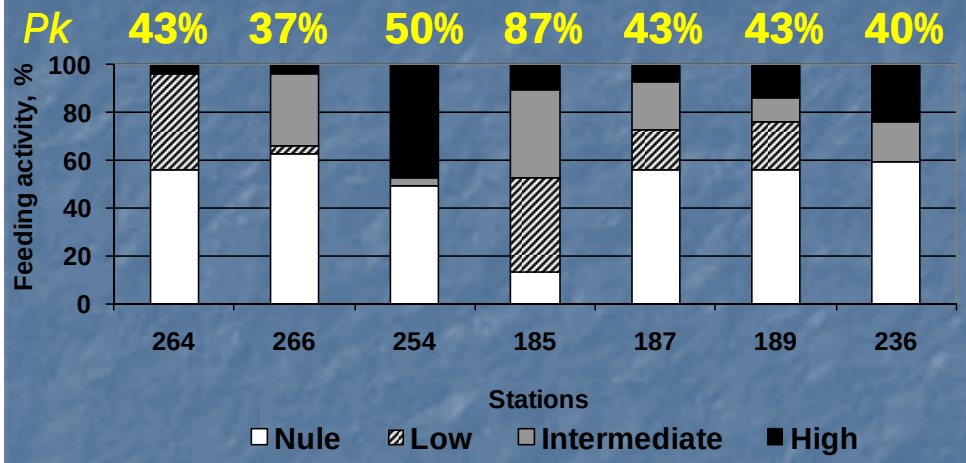
Chlorophytes
Diatoms
Haptophytes
Cryptophytes

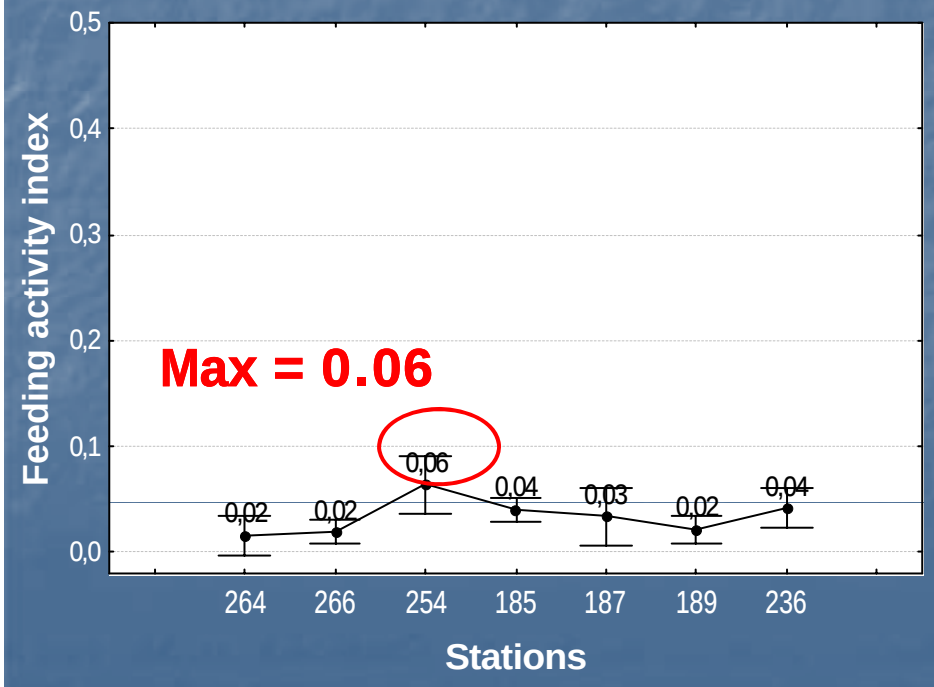
Ciliates
Flagellates
Heterotrophic dinoflagellates

Bloom diatom *Rhizosolenia setigera*
St.266-10m

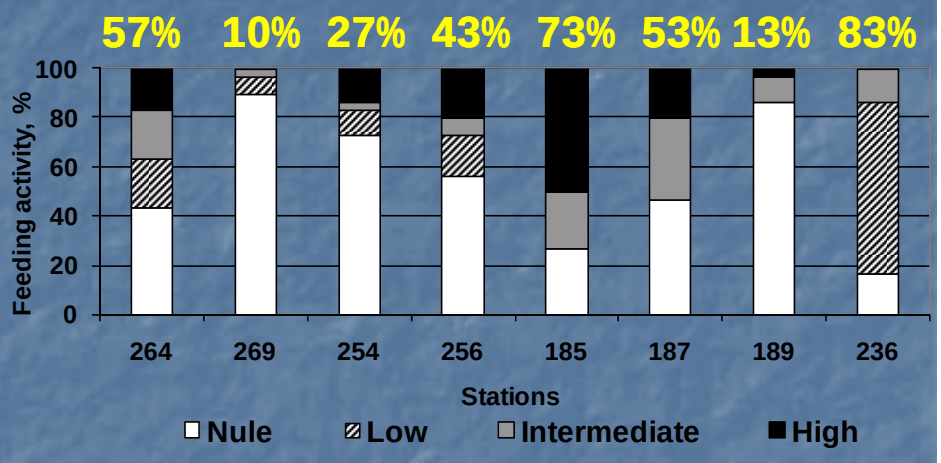
FEEDING ACTIVITY

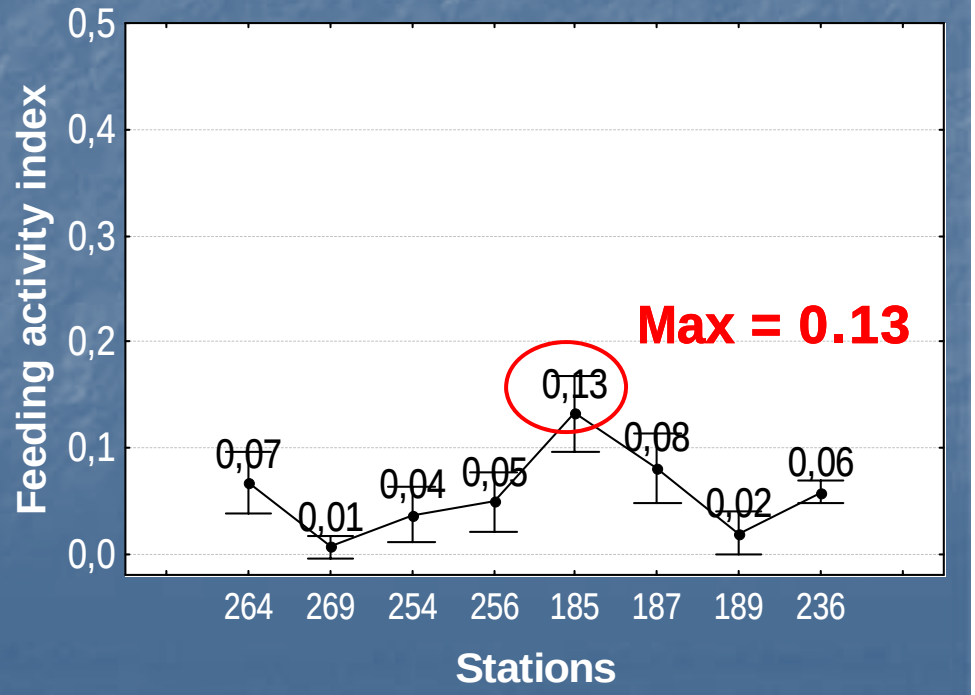
Calanus australis ♀





Calanus australis C5





FEEDING ACTIVITY

Calanus australis **adult females and C5**

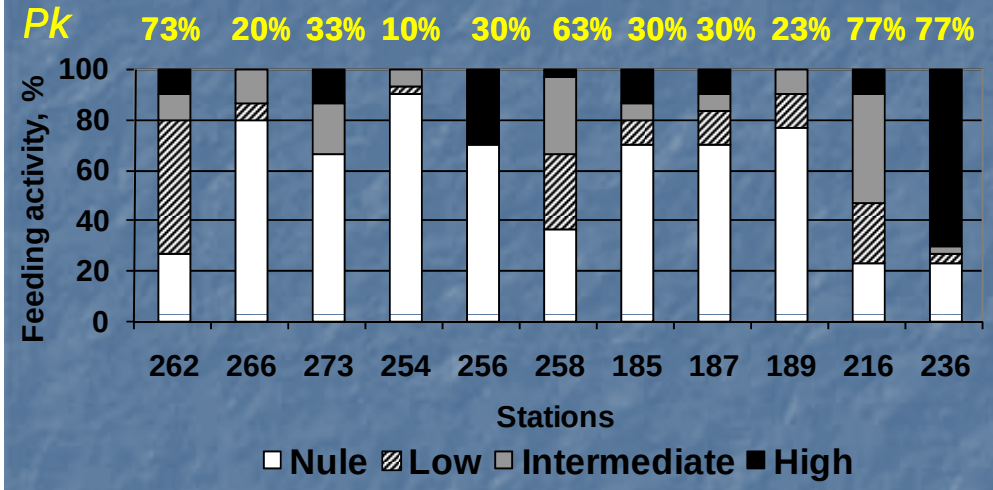
Most copepods were not feeding

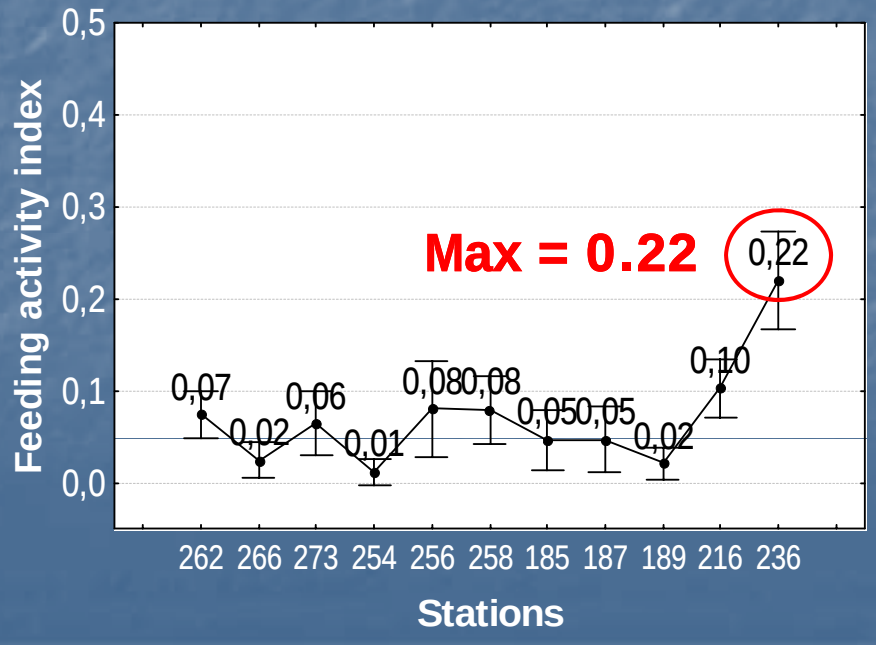
When feeding, mostly at low levels

Both stages were feeding at similar levels

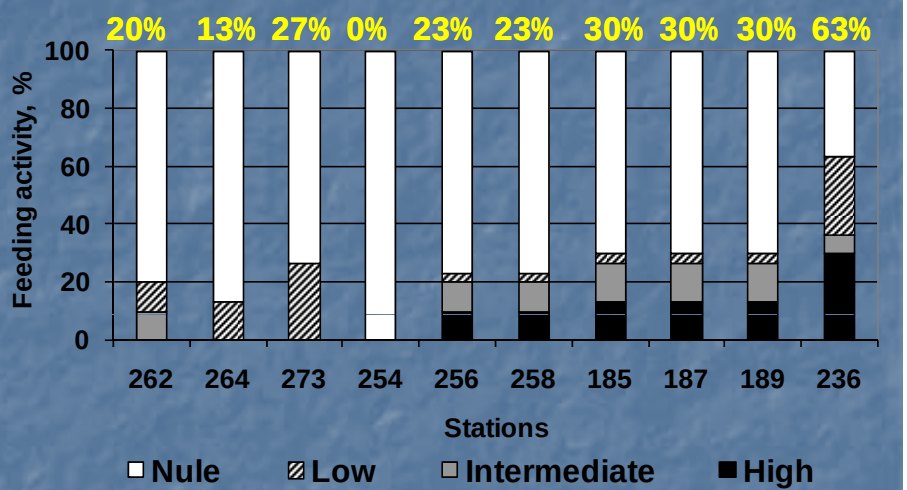
FEEDING ACTIVITY

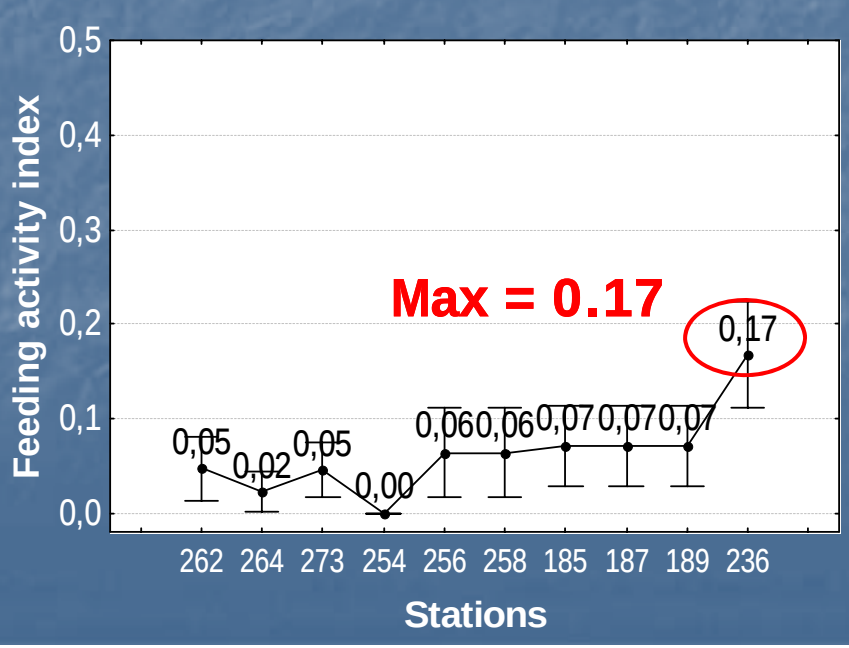
Drepanopus forcipatus ♀





Drepanopus forcipatus C4-F





FEEDING ACTIVITY

Drepanopus forcipatus **adult females and C4-females**

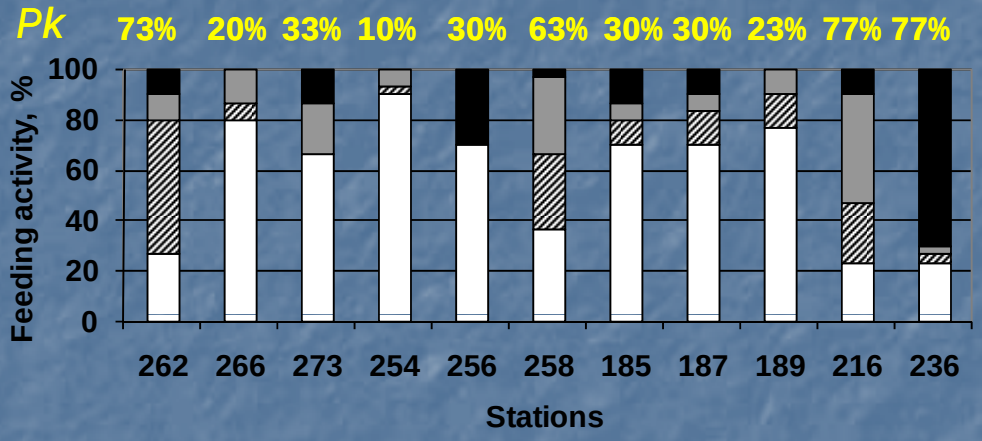
Most copepods were not feeding

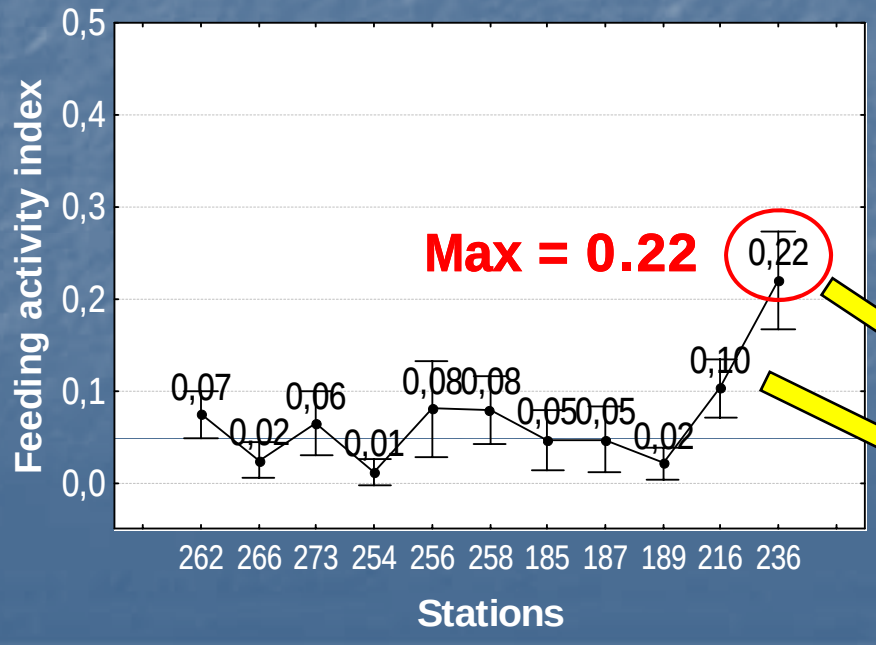
When feeding, mostly at low levels

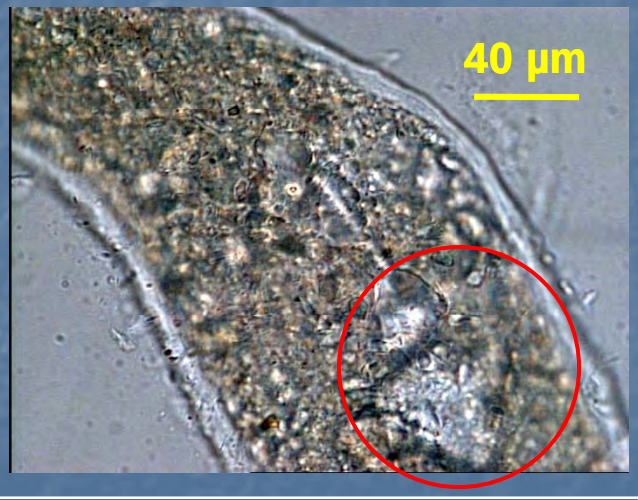
Both stages were feeding at similar levels

FEEDING ACTIVITY

Drepanopus forcipatus ♀

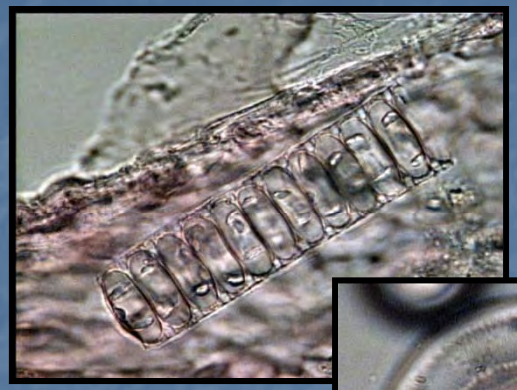




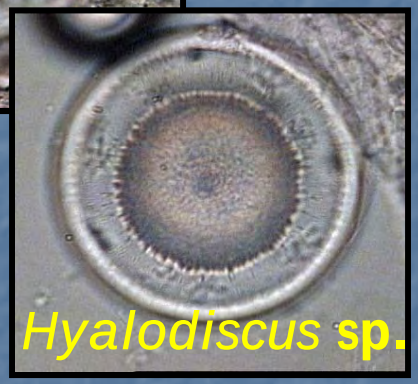


Plenty of inorganic particles (quartz???)

DIATOMS

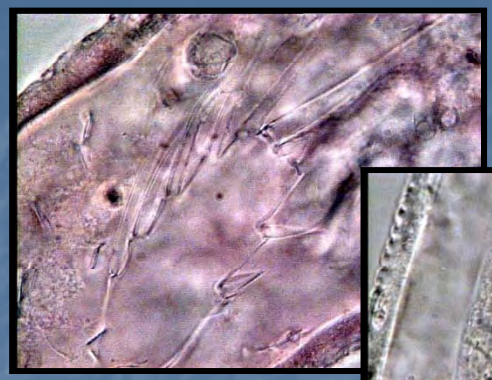


Paralia sulcata



Hyalodiscus **sp.**

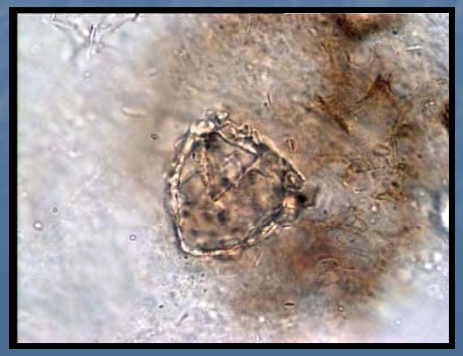
METAZOA



Copepod leg

Copepod nauplius

CILIATES



Loricate tintinnid

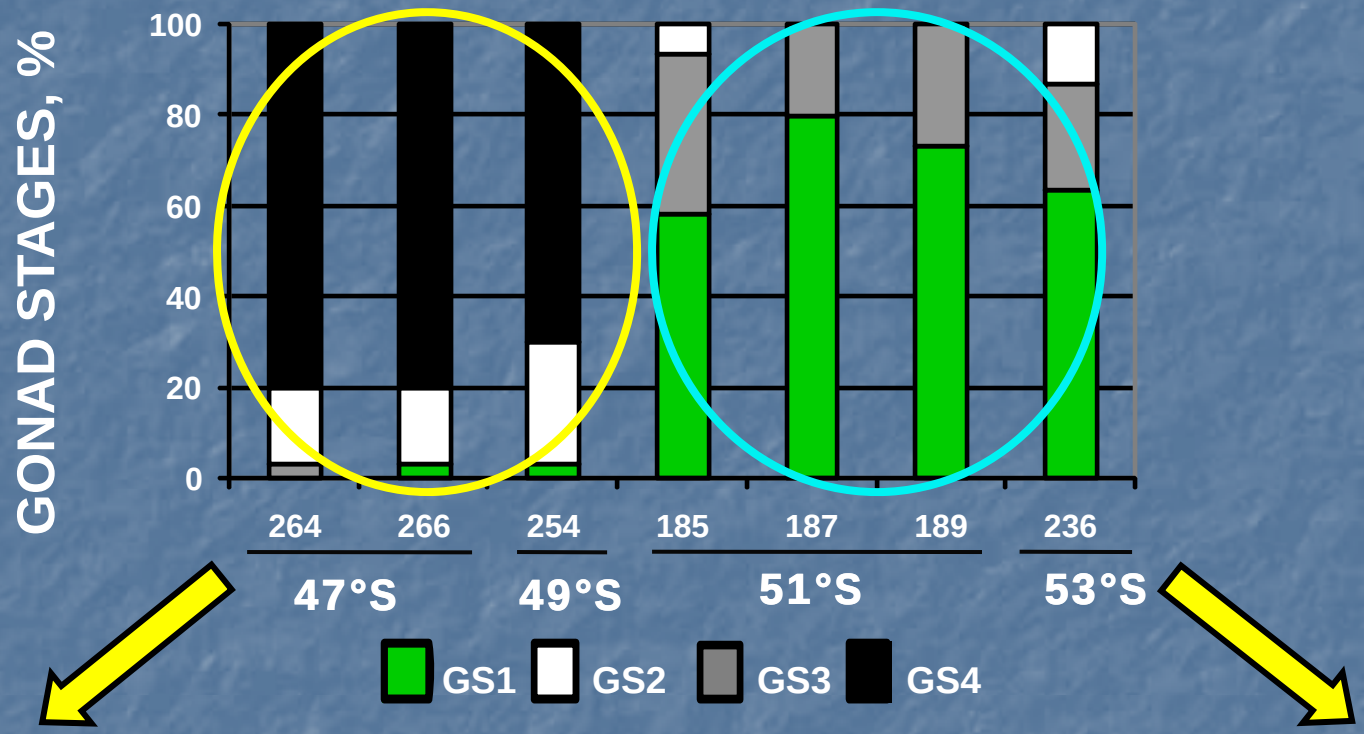
DINOFLAGELLATE CYSTS

Polykrikos schwartzii

Lingulodinium

REPRODUCTIVE ACTIVITY

Calanus australis ♀



Northern St.
> mature GS4

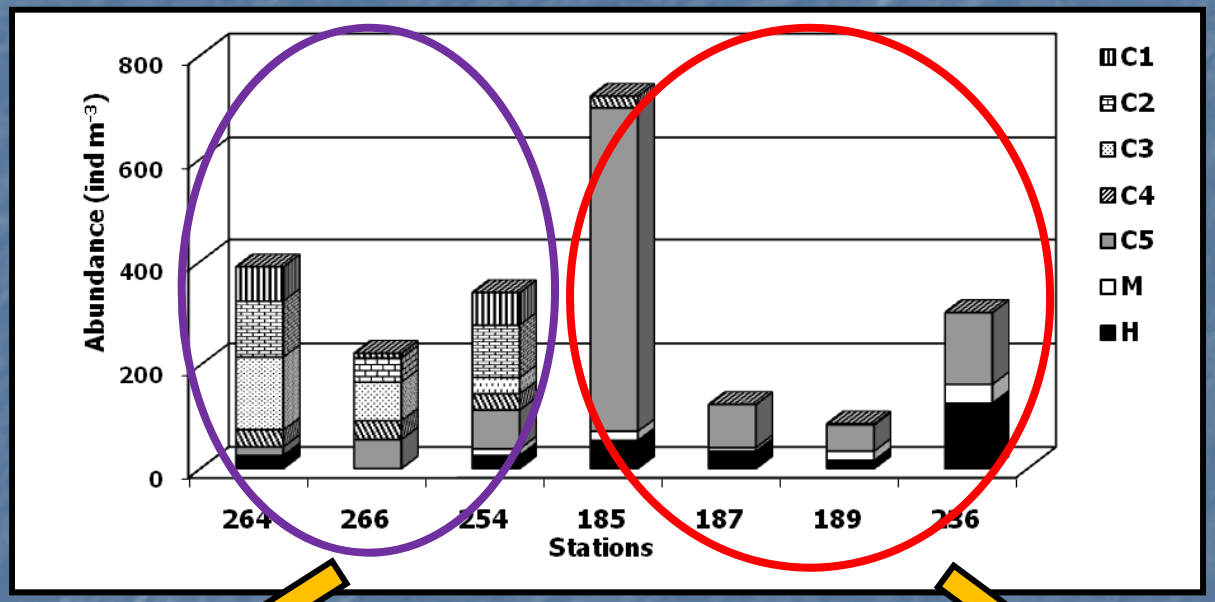
Southern St.
> immature GS1

AGE STRUCTURE

Calanus australis ♀

NORTH

- ❖ Mostly mature females
- ❖ All stages present
- ❖ Early C1-C3 dominated



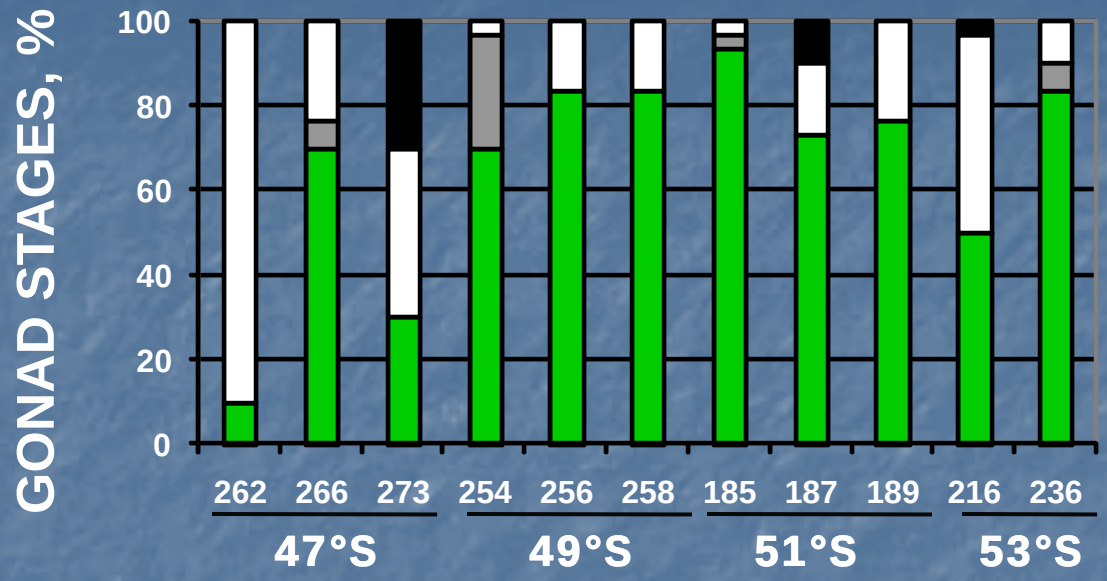
SOUTH

- ❖ Mostly immature females
- ❖ Early C1-C3 absent
- ❖ Immature C5 dominated

"YOUNG" DEVELOPING POPULATION

"OLD" LETHARGIC POPULATION

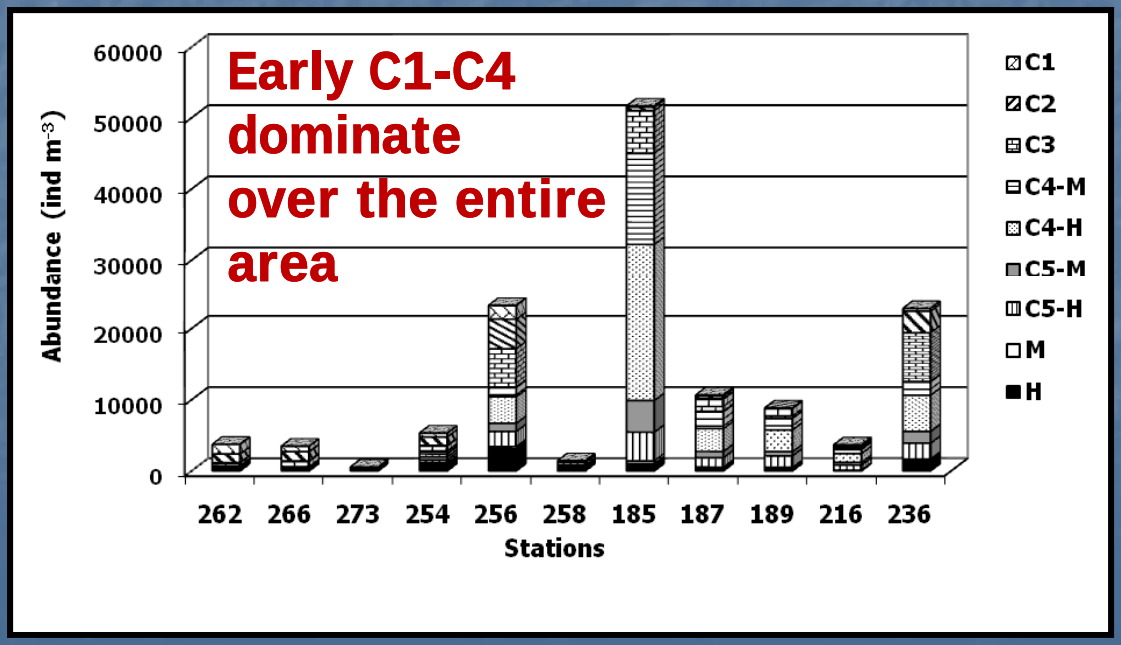
REPRODUCTIVE ACTIVITY



Drepanopus forcipatus ♀

> immature GS1 females between spawning events

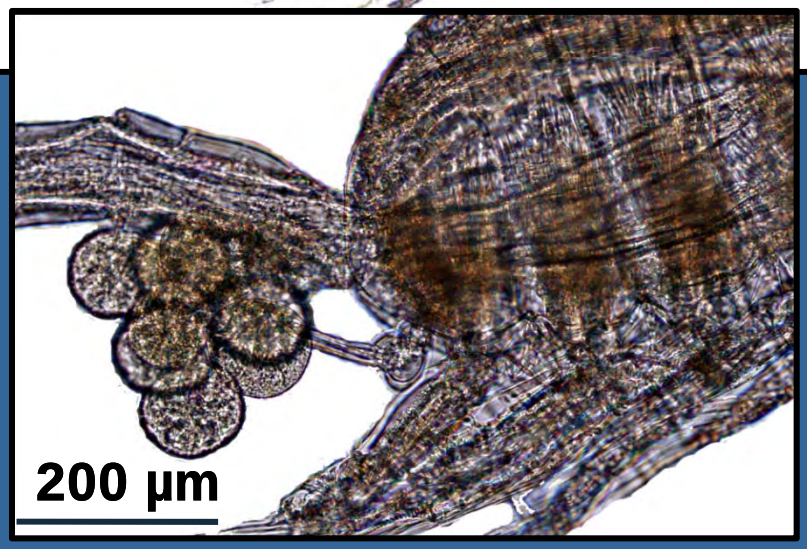
AGE STRUCTURE

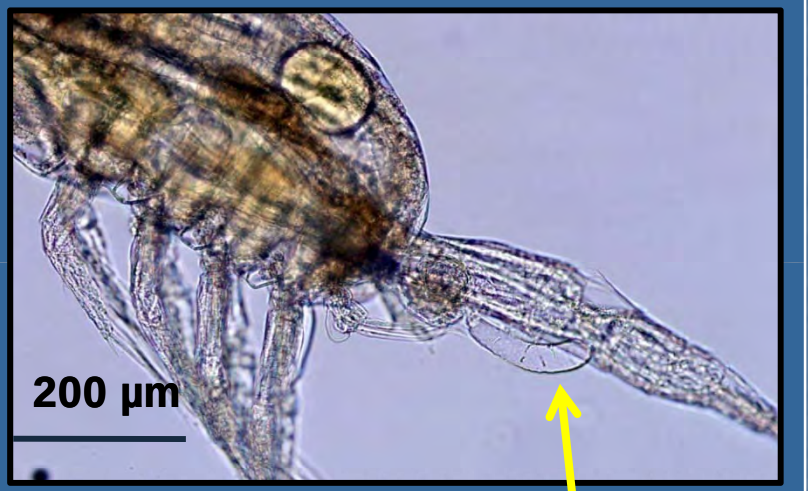


STILL DEVELOPING POPULATION

REPRODUCTIVE ACTIVITY

Drepanopus forcipatus ♀





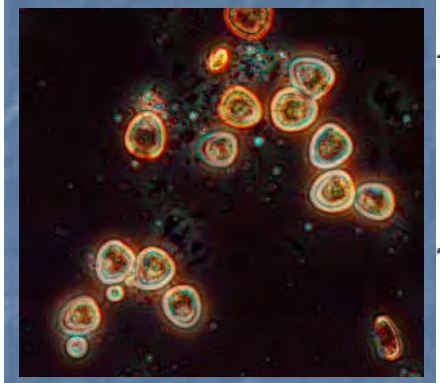
Spermatophore

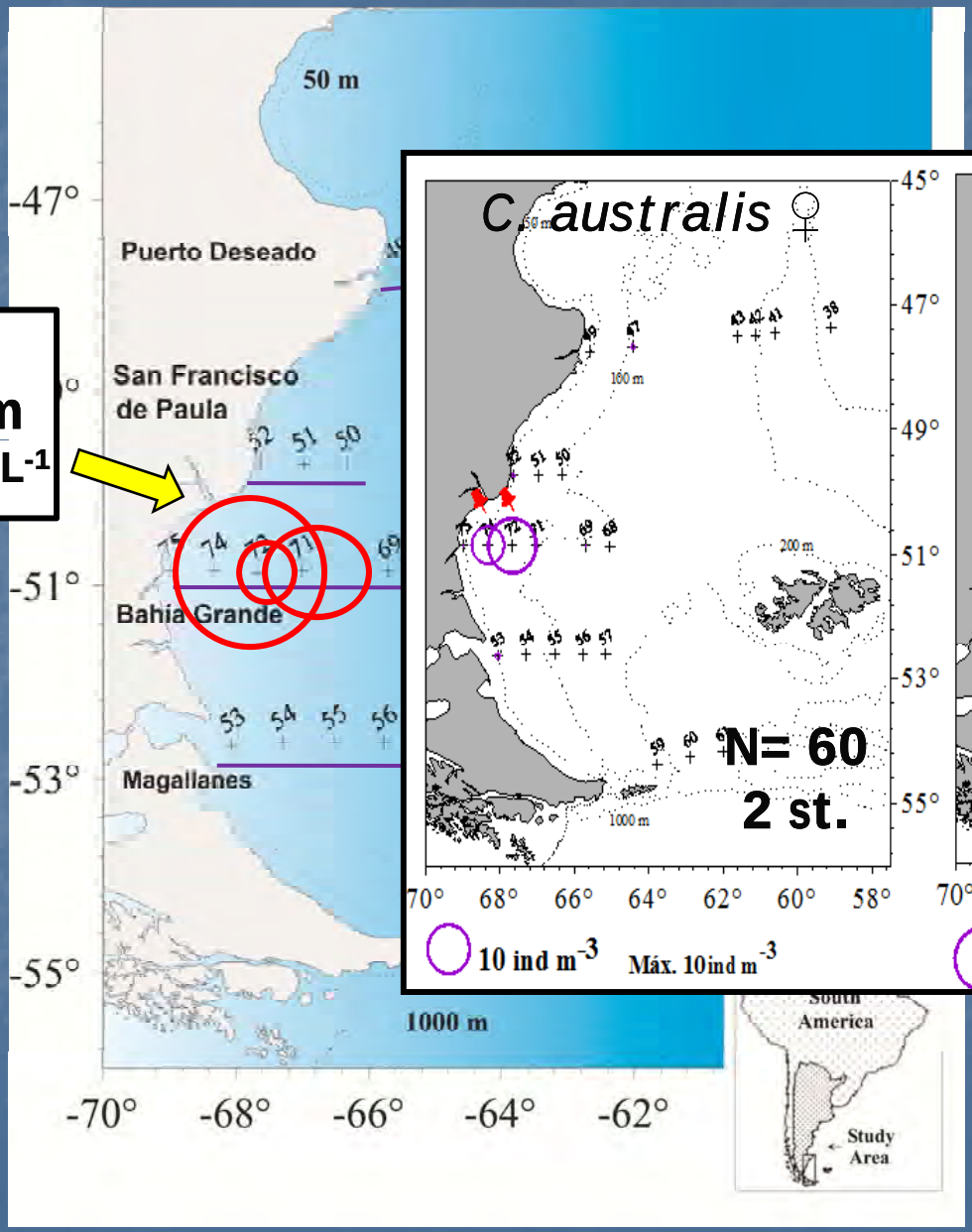

EARLY SPRING 2005
BLOOM CONDITIONS
PUERTO DESEADO
0.20
ARA "Puerto Deseado"
October, 2005
GEF Patagonia-1 cruise
See
poster
S2-6933

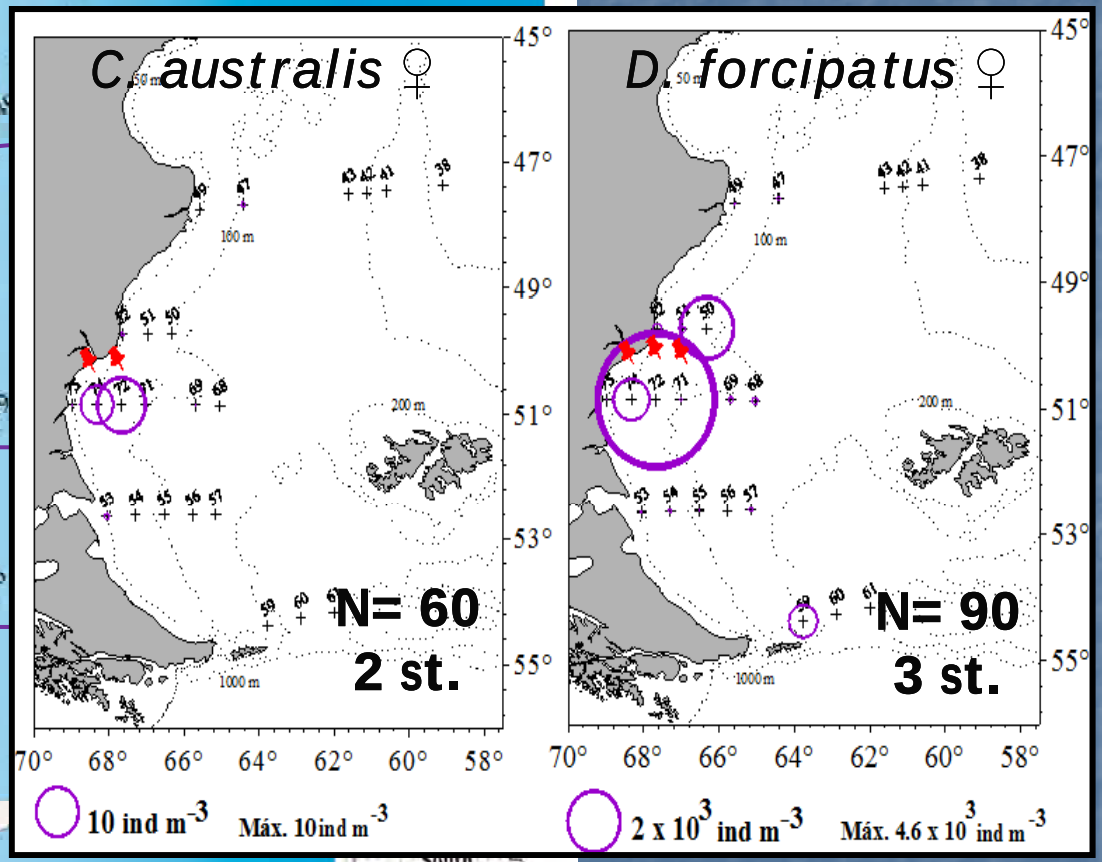
❖Both copepods' maximal spring abundances agreed spatially with a bloom occurred in the inner shelf area of Grande Bay

Prorocentrum minimum **bloom**

Max. 10 x 10^6 cells L^{-1}



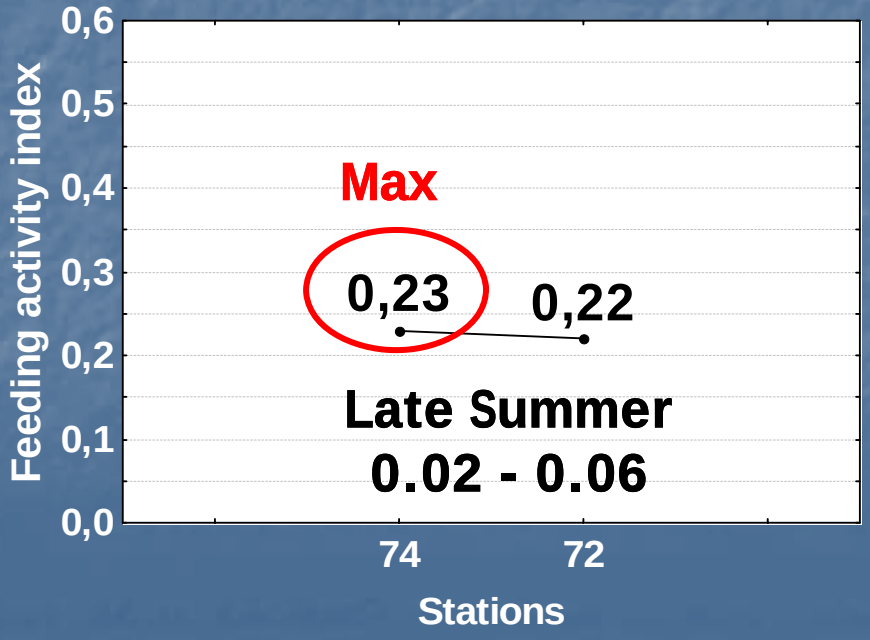




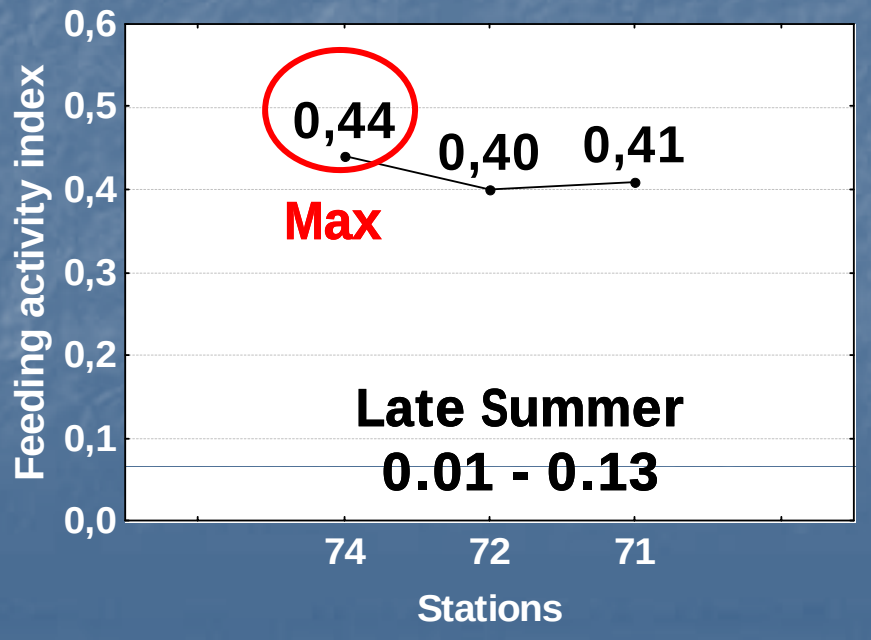
FEEDING ACTIVITY

- **Most copepods were feeding**
- **Feeding copepods, mostly at high levels**
- ***D. forcipatus* had feeding levels 2 times higher than *C. australis***

Calanus australis ♀



Drepanopus forcipatus ♀



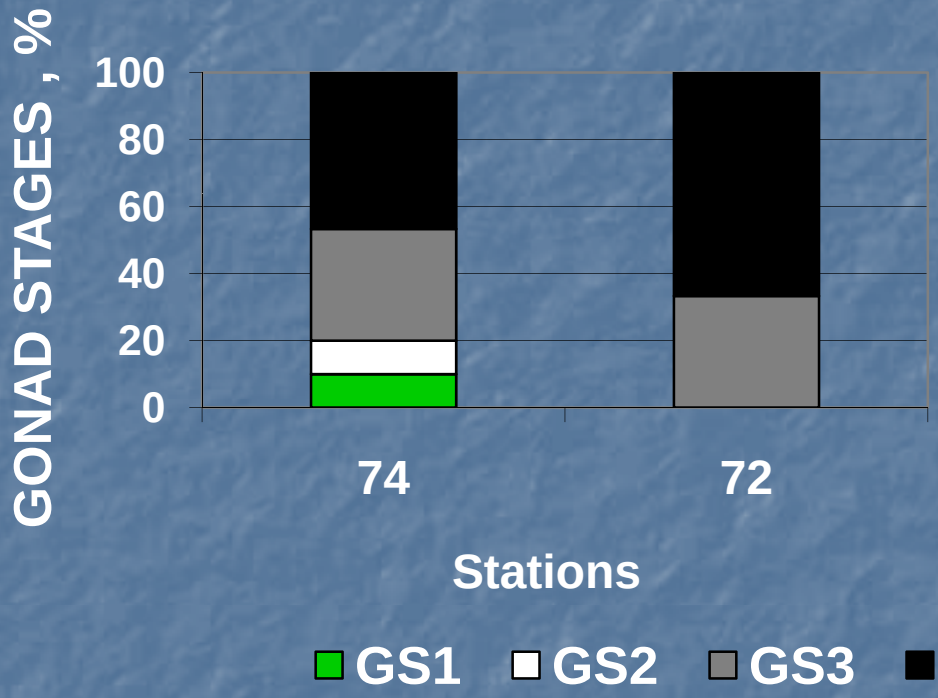
❖ **Both copepods species may have different feeding strategies:**

Drepanopus forcipatus ♀

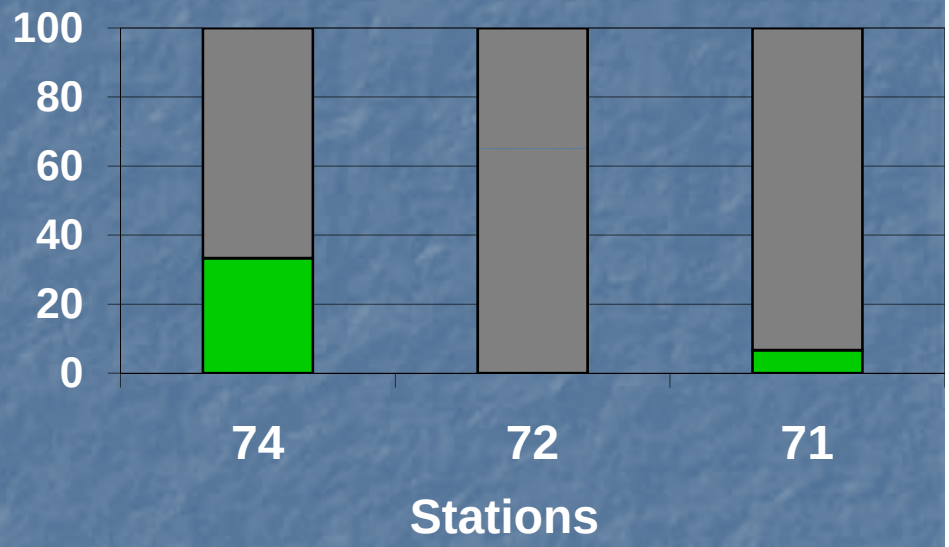
Prorocentrum minimum loaded guts

REPRODUCTIVE ACTIVITY

Calanus australis ♀



Drepanopus forcipatus ♀



GS1 GS2 GS3 GS4

> MATURE GS4

> MATURE GS3

CONCLUDING REMARKS

❖ **This is the first study carried out in the southern Patagonian shelf ecosystem on the feeding and reproductive aspects of the copepods** *Calanus australis* **and** *Drepanopus forcipatus*

❖ **Feeding activity index (=** *feeding copepods proportion x feeding activity intensity*) **would be a good indicator of population feeding state**

❖**Optimal food-size low abundances during summer determined low reproductive and feeding activities in both copepods**

❖**Both copepods would have developed different strategies to overcome bad food conditions during summer:**

Drepanopus forcipatus
would have opportunistic behavior, and benefit from smaller particles

Calanus australis
would feed mainly on >10 µm particles, which were too few. Thus *Ca* **may stop development**

CONCLUDING REMARKS

❖ **During** *Prorocentrum minimum* **spring bloom, both copepods had different behavior:**

D. forcipatus **consumed loads of** *P. minimum* **while** *C. australis* **did not**

Possible explanations:

Size? / Palatability? / Lipid reserves in Calanus australis?