Spatial distribution of chaetognaths along with oceanographic conditions off the Northern Bicol Shelf, Philippines (Pacific Coast)

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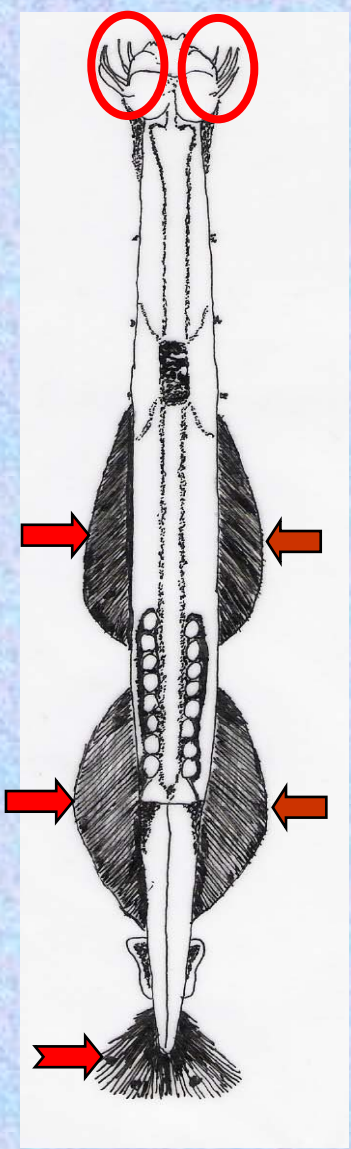
INTRODUCTION

Phylum Chaetognatha

- Vermiform marine invertebrates
- “ Arrow Worms or Glass Worms”
- 150 species
- 24 genera
- 10 families
- colorless, transparent, and slightly opaque
- torpedo-shaped body



Horizontal and Vertical distribution

- exclusively marine organisms and majority planktonic (Johnson 2005)
- can be found in all oceans (Kehayias 2003)
- dominance varies both horizontally and vertically (Reeve 1970)
- no species can be found in all depths at all latitudes (Hickman 1967)
- geographical distribution varies with latitude (Cheney 1985)
  - variation in water temp, water mass distribution and circulation features

Hickman (1965)

Horizontal

- neritic – resctricted to zone of the continental shelf
- oceanic – far from the shore (open sea)

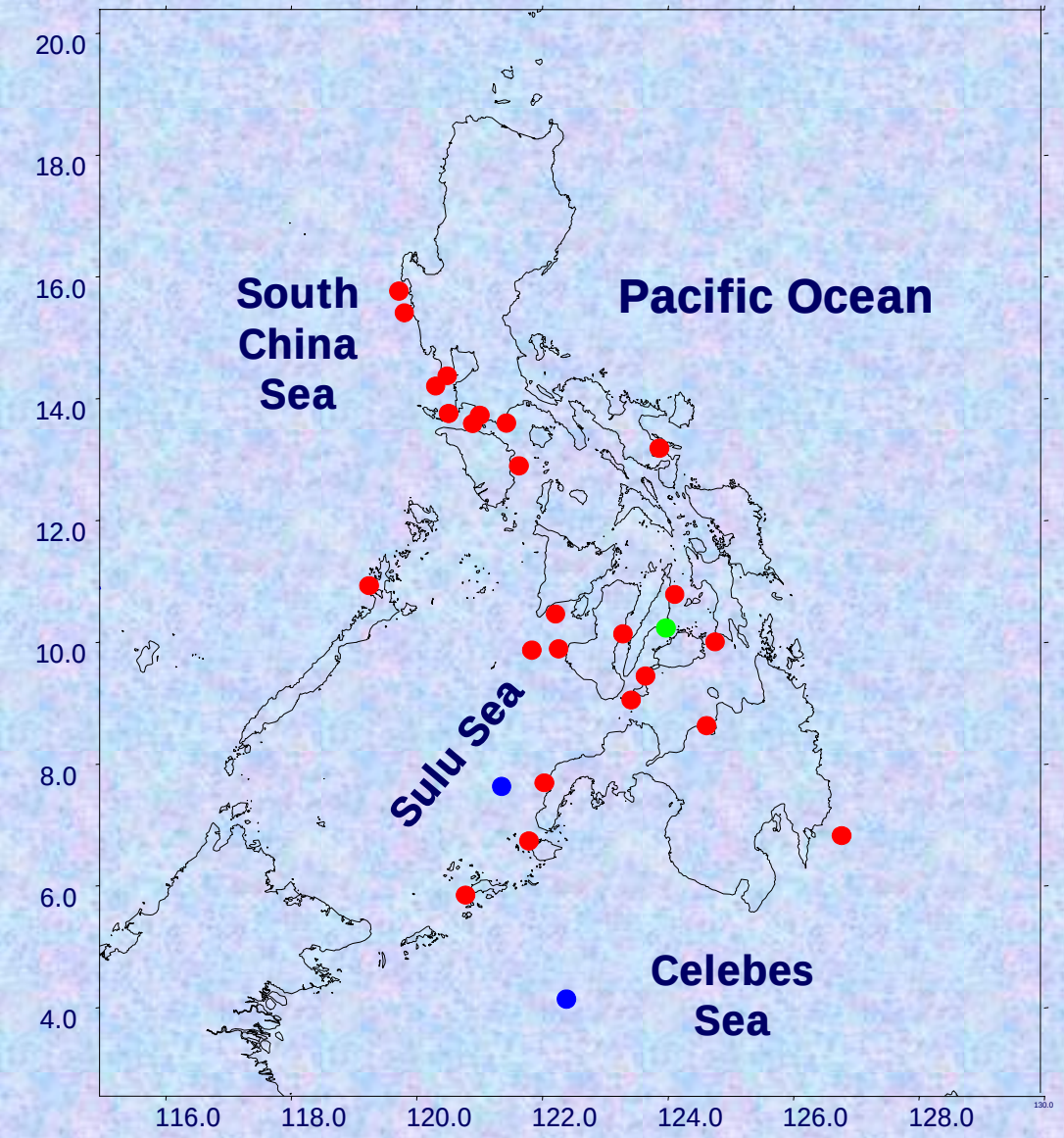
Vertical

- epiplanktonic – not exceeding 100 meters
- mesoplanktonic – 200 – 1000 meters
- bathyplanktonic – below 1000 meters

Importance of Studying Chaetognaths

1. Important components in most marine planktonic communities
2. Active predators/competitors of copepods, other crustaceans and fish larvae/egg
   - play significant role in transfer of energy from copepods to higher trophic levels
3. Indicators for water masses
   - Close relationships w/ environmental variables
   - Display species-specific relationships to water masses
     - horizontal dispersion
     - distinct vertical distribution
   - Categorized according to the type of water masses: warm-water, cold-water, and mixed water (Johnson and Terazaki 2003)
4. Biological indicators
5. Plot patterns of currents and validate occurrence of certain phenomenon like upwelling events and frontal formation
6. Valuation of the reduction of larval abundance of fish and other marine fauna

Studies in the Philippines



Major Studies

- Michael 1919
- Jumao-as and Westernhagen 1978
- Johnson 2005

Others

- Bieri 1959
- Alvariño 1967
- Rottman 1978

Focused mainly on the western waters of the Philippines and some limited to specific water basins

OBJECTIVE OF THE STUDY

"Examine the species composition, abundance, and distribution of chaetognaths off the Northern Bicol Shelf, Philippines (Pacific Coast) and relate these to hydrographic features and processes."

Specific objectives

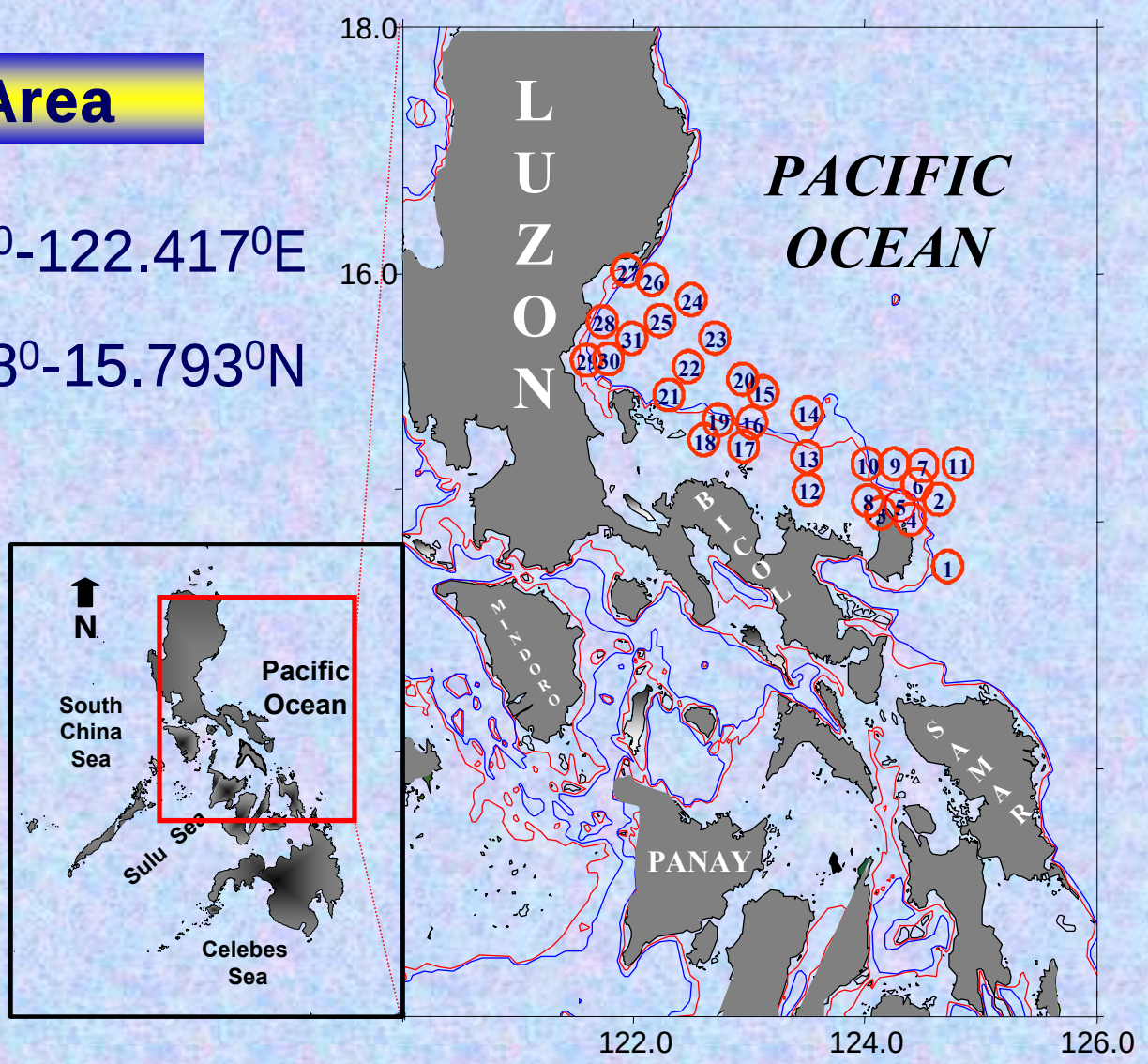
- determine the species composition, abundance and distribution of chaetognaths
- relate hydrographic conditions to their composition, abundance and distribution

MATERIALS AND METHODS

Study Area

- 124.802^0-122.417^{0}E

and 11.258^0-15.793^{0}N



Stations locations off the Northern Bicol Shelf, Philippines (Pacific Coast)

DATA COLLECTION AND PROCESSING

Oceanographic Cruises

Bicol Shelf (Pacific Coast)

- 1-11 April 2001
- 31 stations
- R/V DA-BFAR

Sampling methods

- Smith and Richardson (1977)

Field Sampling

Double Oblique Tow (DOT)

- *60-cm diameter ring*
- *335µm mesh*
- *fitted with fowmeter*
- *maximum depth 100m*

LABORATORY ANALYSIS

Sorting and Identification

- samples preserved in 10% buffered seawater-formalin solution
- chaetognaths were sorted out from the samples
- identified into species level
  - dissecting and compound Microscope
  - keys: Cassanova (1999), Bieri (1991), Pierrot-Bults (1988), Michael (1984), Alvariño (1967) and Michael (1911)

Biomass

- vol. displacement method ($ml.\cdot m^{-3}$)

Density

- ind.$\cdot 100m^{-3}$
- plotted on maps of the study area

Hydrographic profiles

- SEABIRD CTD profiler
- oceanographic data include
  - temperature, chlorophyll *a* and nutrients: nitrate, nitrite, phosphate, and silicate

DATA ANALYSIS

Cluster Analysis (Q and R)

- examine similarities in distribution of the different species
- **Program COMM** (Piepenburg and Piatkovski 1992)

Q-mode cluster analysis

- examine station clusters

R-mode analysis

- assemblages of species showing similar relative abundances in the same stations

✓**Note: Species having 10 % of occurrence and below not included in the analysis.**

✓ **avoid derivation of erroneous relationships in the community analysis**

✓ **they are considered as "RARE" species**

RESULTS

Species Composition

Total = 9,029
26 species
5 genera

- Excluding unknown Sagitta & juvenile

- Mostly epiplapktonic

- **occurrence of meso & mesobathyplanktonic**
- **due to upwelling**

Species	Species
Sagitta enflata	*Sagitta macrocephala*
Sagitta neglecta	*Sagitta regularis*
Sagitta serratodentata	*Sagitta tasmanica*
Sagitta bipunctata	*Sagitta nagae*
Sagitta ferox	*Pterosagitta. draco*
Sagitta bedoti	*Sagitta pulchra*
Sagitta oceanica	*Sagitta bedfordii*
Sagitta robusta	*Sagitta sp.*
Sagitta juvenile	*Krohnitta pacifica*
Sagitta minima	*Krohnitta subtilis*
Sagitta pacifica	*Eukrohnia fowleri*
Sagitta decipiens	*Sagitta septata*
Sagitta hexaptera	*Sagitta setosa*
Sagitta johorensis	*Spadella sp.*

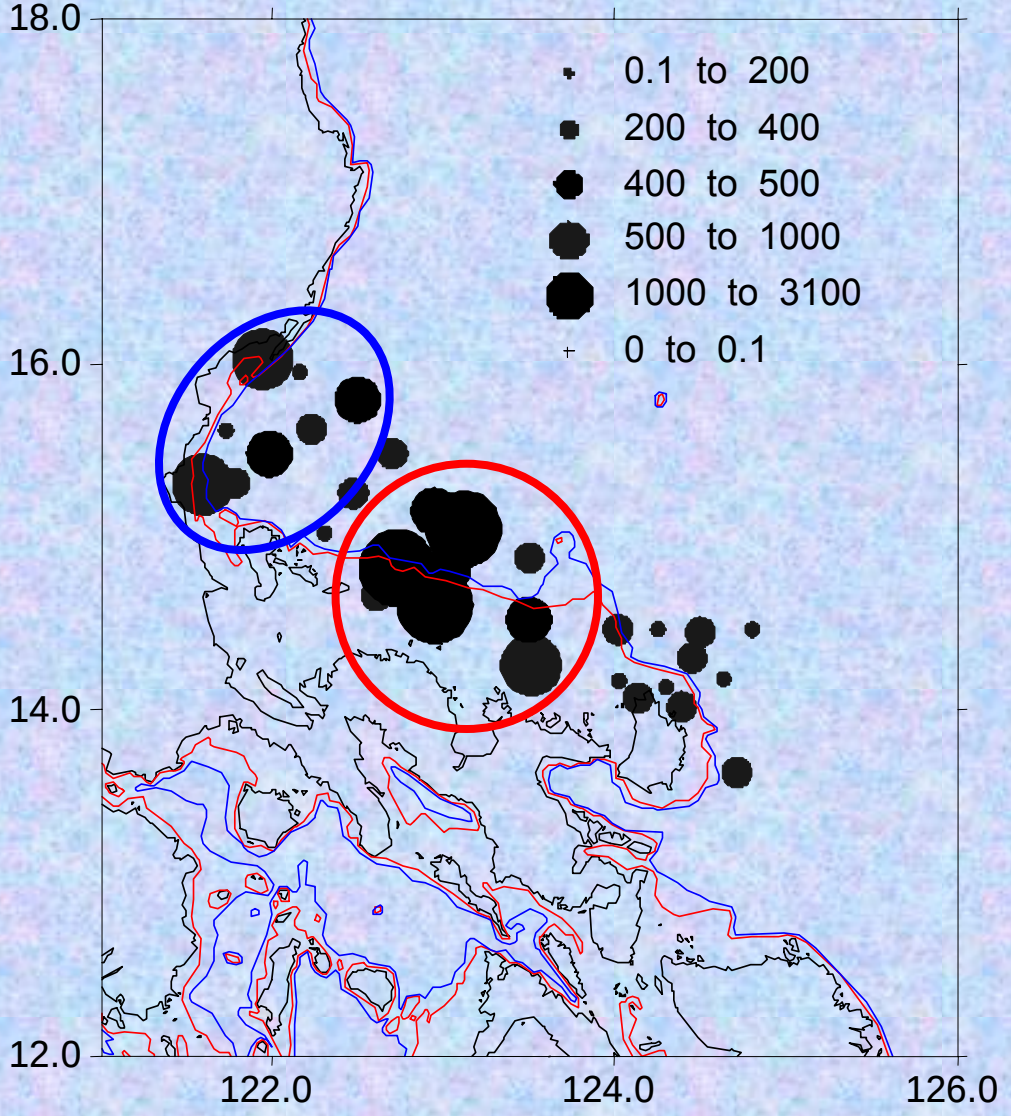
Results

Top ten

Species	No. of individuals	mean	sd	%
Sagitta enflata	3654	1.83	2.70	41.88
Sagitta neglecta	1170	0.54	0.61	12.50
Sagitta serratodentata	1283	0.45	0.47	10.22
Sagitta bipunctata	495	0.32	0.82	7.31
Sagitta ferox	488	0.25	0.47	5.67
Sagitta bedoti	380	0.21	0.46	4.72
Sagitta oceanica	265	0.14	0.40	3.25
Sagitta robusta	216	0.14	0.34	3.21
Sagitta minima	303	0.10	0.17	2.30
Sagitta pacifica	103	0.07	0.22	1.68
				92.74
no. of individuals	9,029			
no. of species	26			
no. of genera	5			
mean	435.8			

RESULTS

Density Distribution



Mean

- **435 ind.•100m^{-3}**

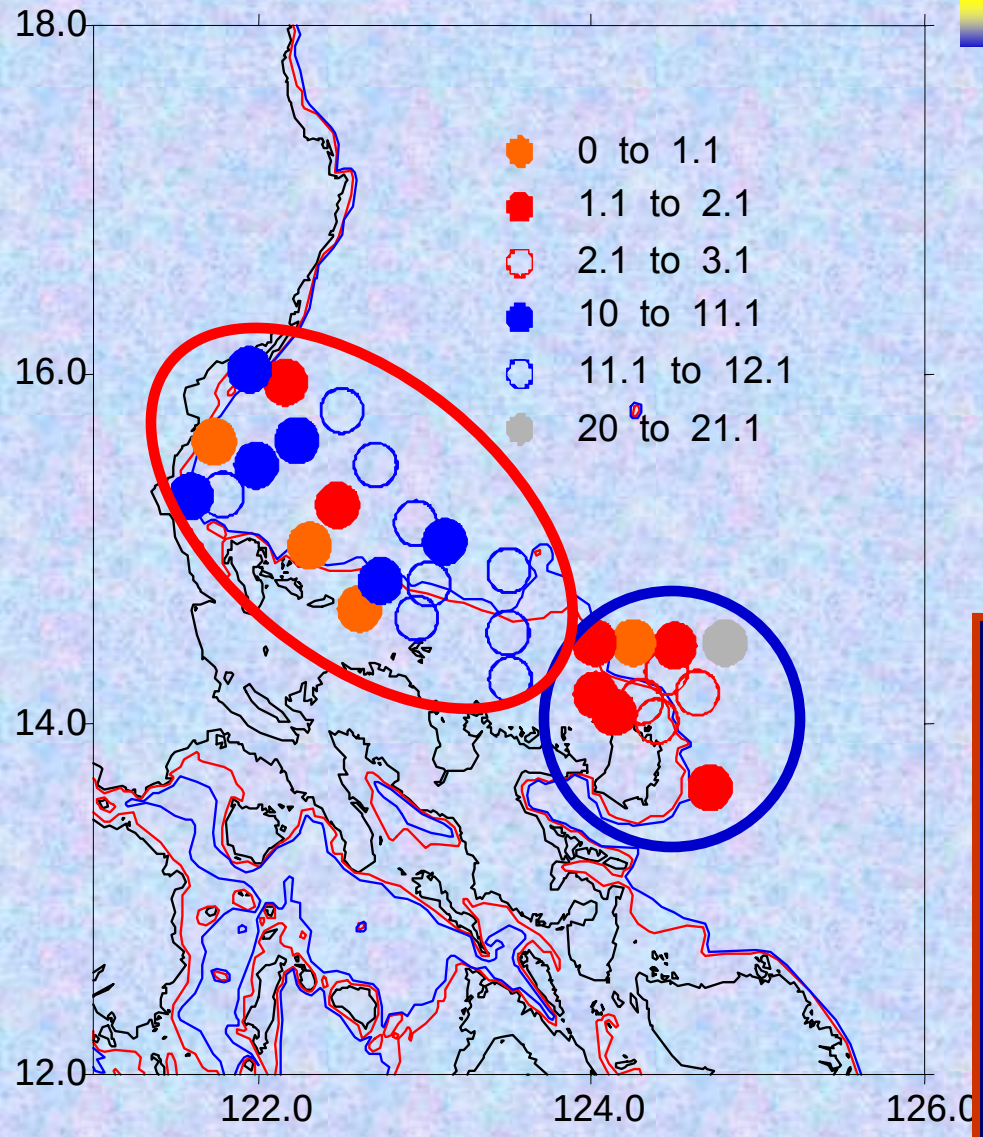
Range

- **2.8-3,089 ind.•100m^{-3}**

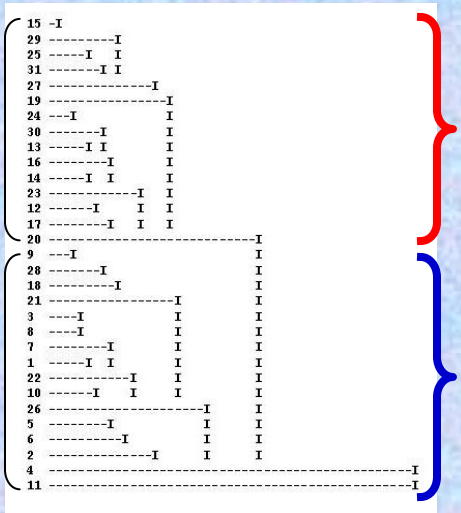
Highest density

- eastern of Pollilo Island (red circle)
  - reported upwelling zone (Amedo *et al.*, 2002)
- moderately high (western inner shore) (blue circle)

Station Clusters



2 major station clusters

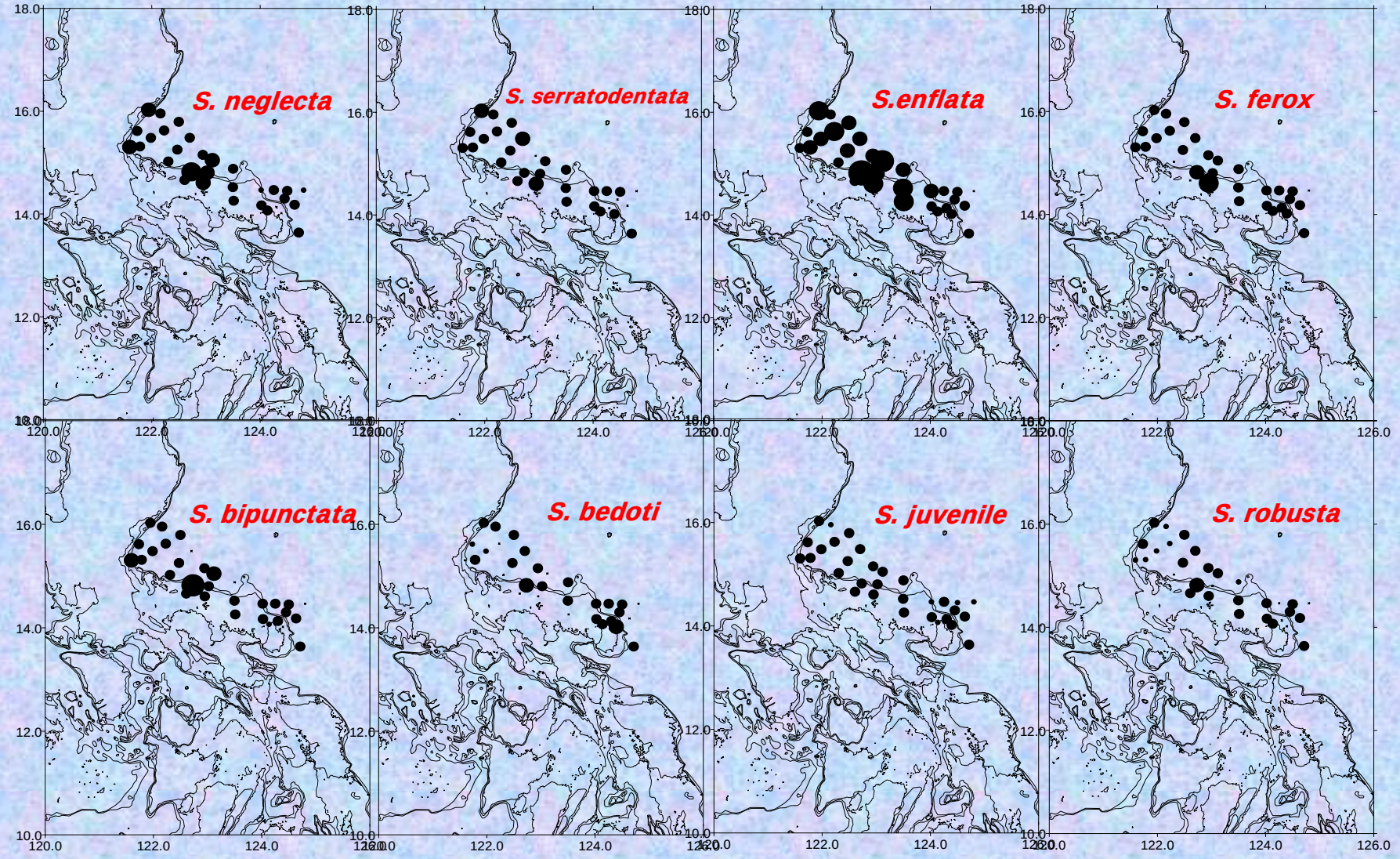


- **Western station clusters**
- **Eastern station clusters**

- **formed primarily by differences in densities**
- **not delineated by rigid boundaries**
  - differences in abundance and relative densities
  - not by presence or absence of any species

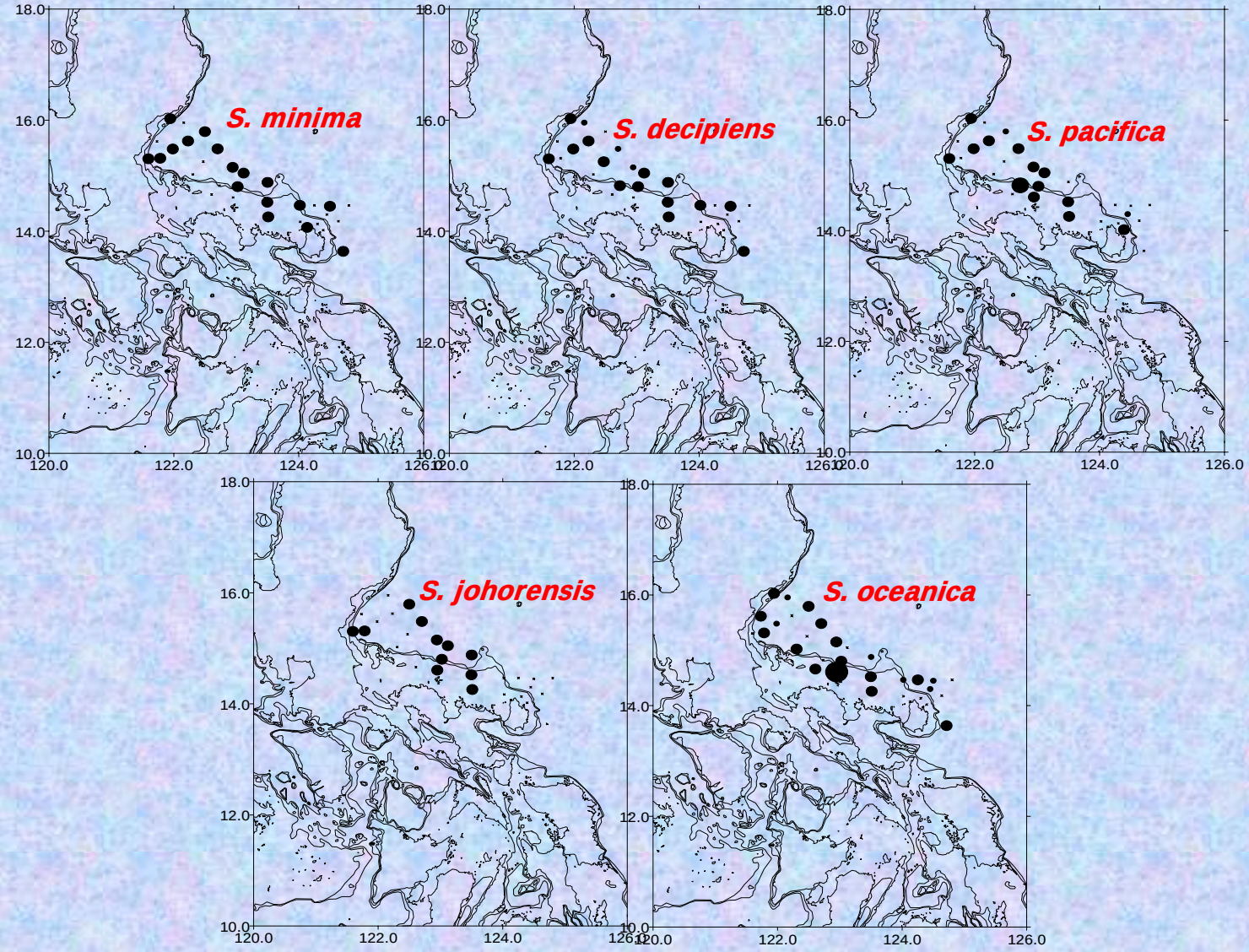
SPECIES ASSEMBLAGES

Assemblage A: High abundances and occur frequently



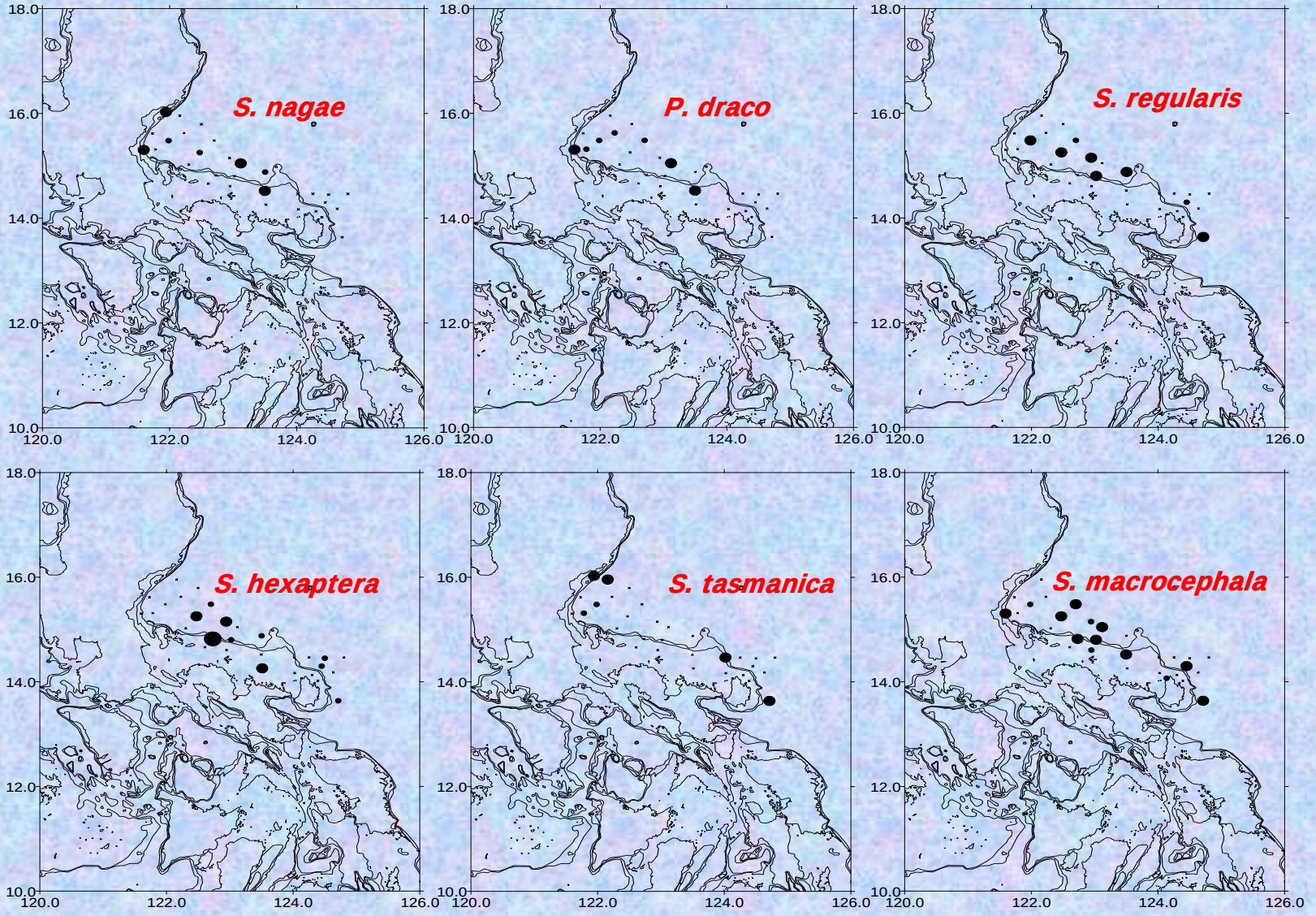
SPECIES ASSEMBLAGES

Assemblage B: Moderate abundances and occurrence

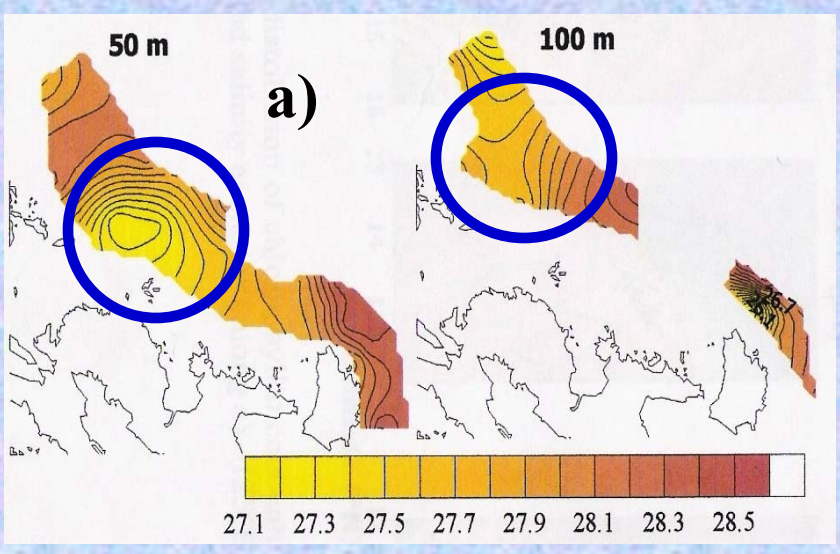


SPECIES ASSEMBLAGES

Assemblage C: Low abundances and occurence

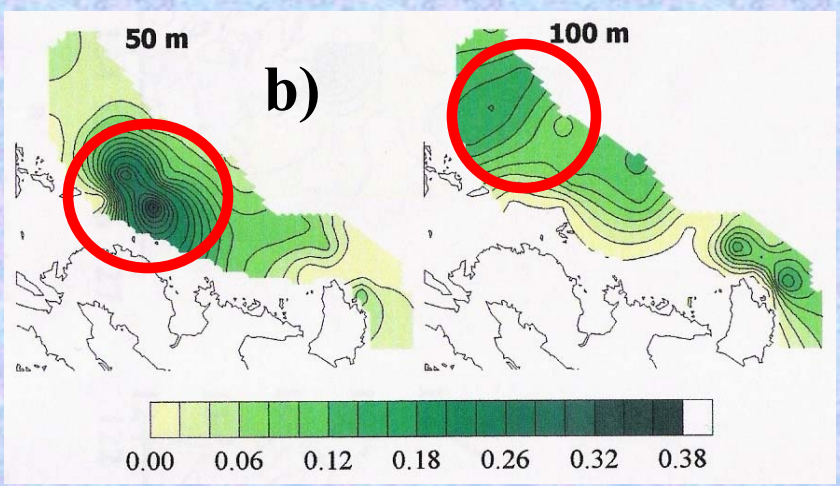


Spatial distribution of:



a) Temperature (^{0}C)

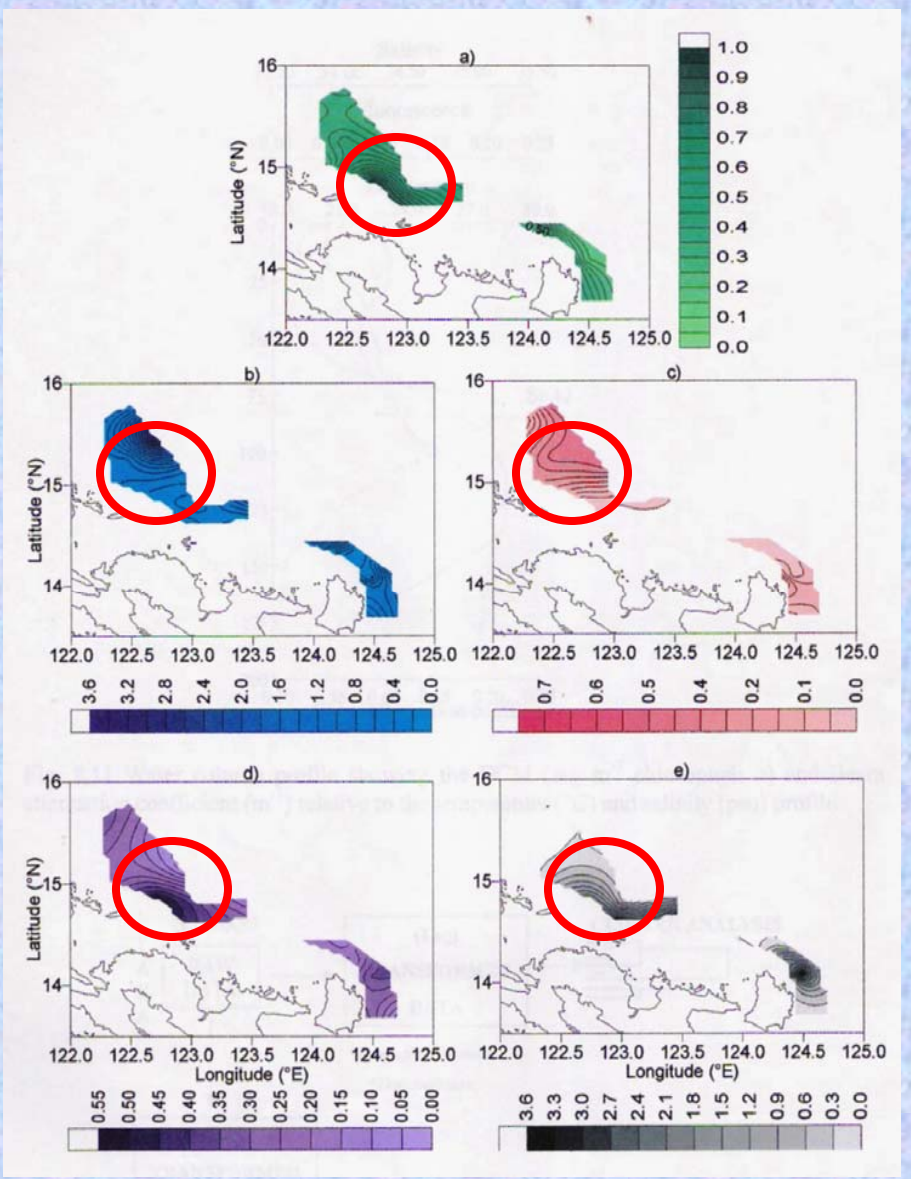
- coldest off eastern of Pollilo Island (northwest of Northern Bicol Shelf)



b) chlorophyll *a* (ug•L^{-1})

- highest concentration recorded off eastern of Pollillo Island (northwest of Northern Bicol Shelf)

Horizontal contours of:



- a) chlorophyll *a* (mg·m-3)
- b) nitrate (µM)
- c) phosphate (µM)
- d) nitrite (µM)
- e) silicate (µM)

↑ Chloropyll *a* ↓ Nutrients

High productivity

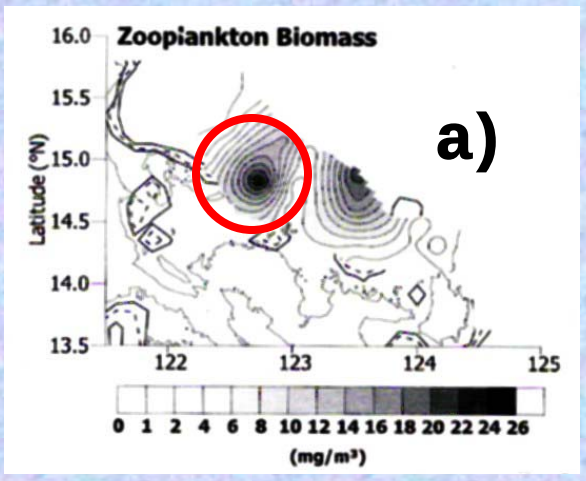
✓ upwelling

Low nutrients

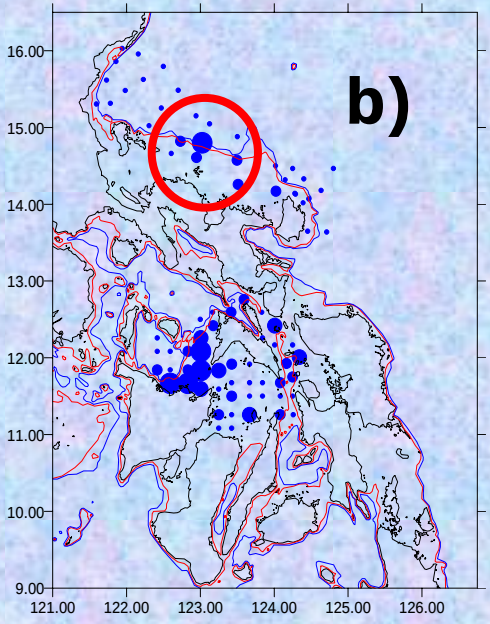
✓ rapid phytoplankton consumption

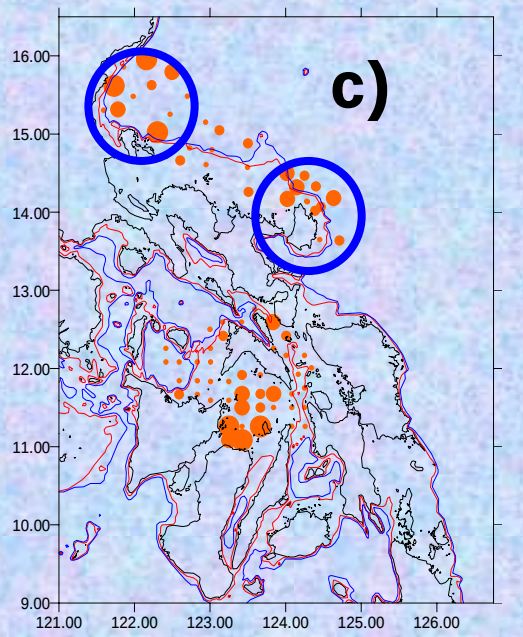
✓ shallow source of upwelled water

Spatial distribution of:



- **a) zooplankton**
  - ✓ Highest off eastern of Pollilo Island
- **b) fish larvae**
  - ✓ high concentration off eastern of Pollilo Island
    - ⇨ relatively low compare w/ previous studies conducted in other area of the Philippines (Estremaduar *et al.*, 2002 and Campos *et al.*, 2002)
- **c) fish eggs**
  - ✓ Highest near the coast
  - ✓ moderately high near Catanduanes





SUMMARY

1. Chaetognath assemblages recorded is consistent with the previous studies.
   - ⇨ Alvariño 1967, Jumao-as and von Westernhagen 1978, Rottman 1978 and Johnson 2005
2. *Sagitta enflata*: most common and abundant
3. Mean density is of the same magnitude as the higher limits recorded in previous studies in other areas of the country.
   - ➢ Gradual change of density from east to west.
   - ➢ Highest concentration off eastern Pollilo Island = upwelling zone
4. 2 major station clusters: eastern and western station clusters.
   - ➢ No apparent demarcation in composition
   - ➢ Aggregation among stations
     - attributed by differences relative abundance and densities
   - ➢ Communities not delineated by rigid boundaries
     - ❖ assemblages more differentiated by abundance and relative densities rather than by species presence or absence

SUMMARY

6. Occurrence of meso and meso-bathypelagic species (*S. decipiens, S. serratodentata, s. macrocephala, Krohnitta subtilis, K. Pacifica and Eukronia fowleri*)
   - Due to upwelling events in the area (Amedo *et al*., 2002)
7. Concentrations of chaetognaths corresponds with the oceanographic data: chlorophyll *a* and temperature, same also with the zooplankton and fish larvae except for nutrients and fish eggs
   - Due to upwelling and chaetognaths ecology/biology (abundance depends primarily on its prey)
   - the latter due to predation (nutrients-rapid phytoplankton consumption and fish eggs-might be predation impact of chaetognaths)
   - Shallow source of up welled water
8. Relatively low abundance of fish larvae compare with the previous study and low egg concentrations in the upwelling zone
   - Due to rapid consumption by chaetognaths aggregation esp. on eggs (mobile incapability)
   - No apparent effect in the zooplankton
     - Zooplankton regenerate massive population and faster

RECOMMENDATION

1. **Further investigations needed to address and verify the mentioned contentions.**

- ✓ Gut content analysis and intensive sampling (vertical, seasonal and ontogenetic distribution of chaetognaths).
  - ❖ Address trophic relationships between chaetognaths, fish larvae and eggs and other zooplankton groups.
- ✓ Nutrient regeneration, productivity and oceanographic modeling .
  - ❖ Determine dynamics of upwelling zone of NBS and its possible role in overall production along the eastern pacific.

Maraming salamat!

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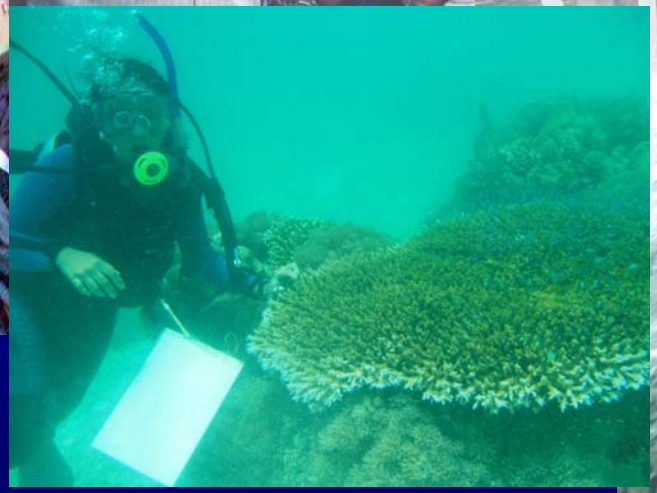

This study forms part of Ms. Mary Mar P. Noblezada Master's Thesis