

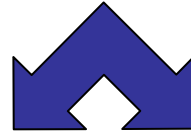
# Sampling methodology for benthos in mangrove estuaries



**Ann Vanreusel**



## Sampling



Qualitative

Semi-quantitative

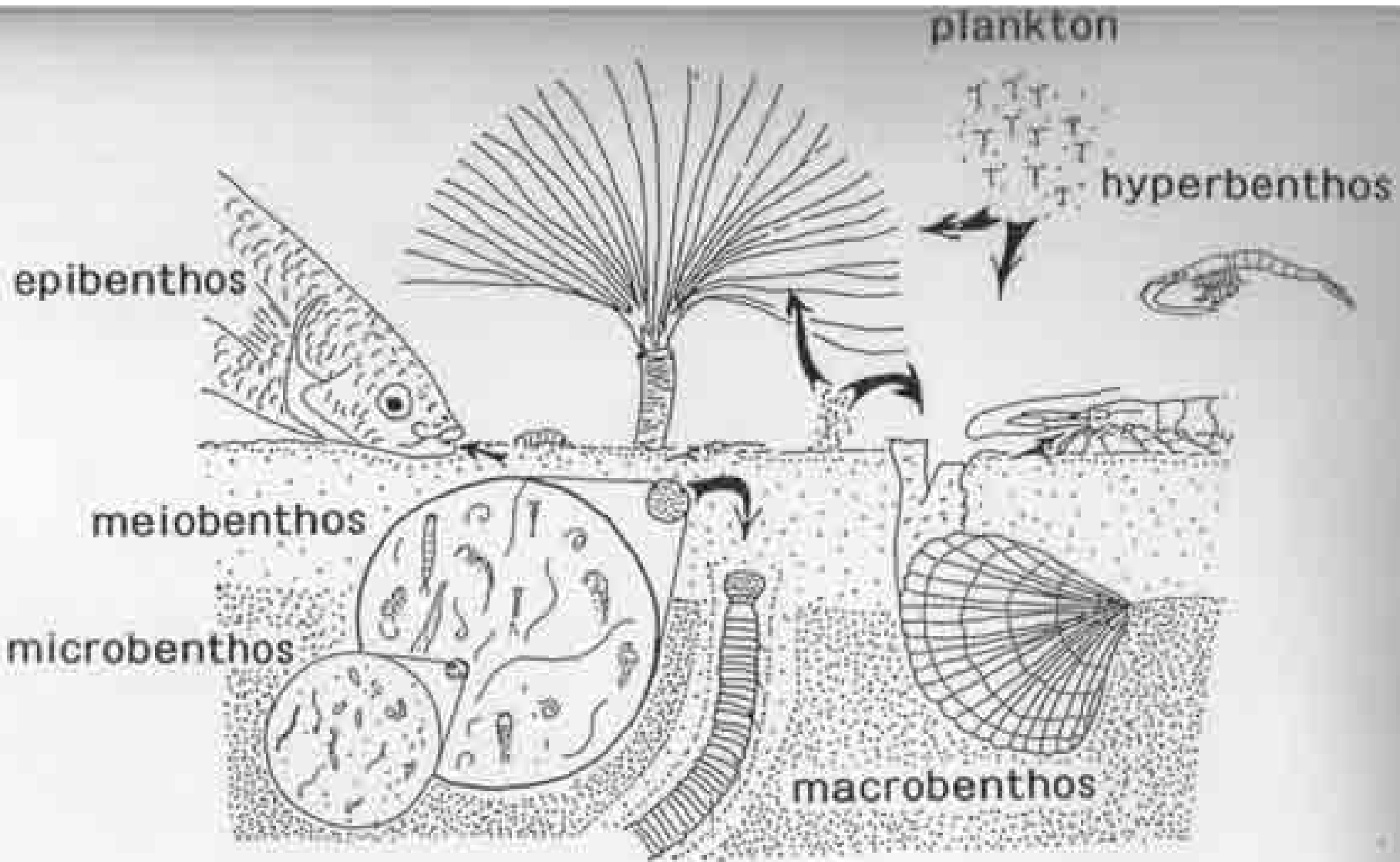
Quantitative

Per unit of surface or volume

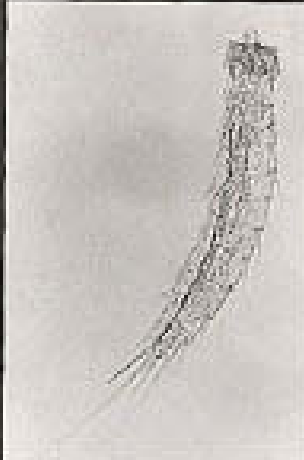
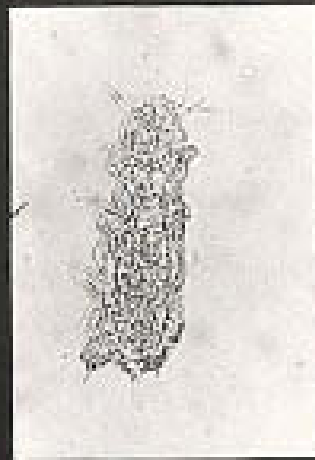
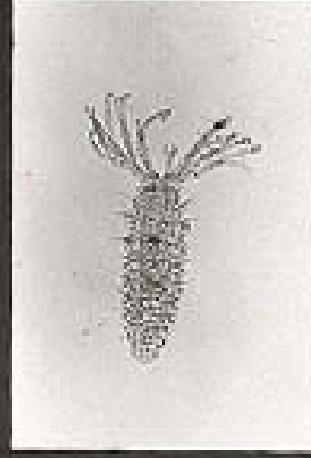
### Ecological research

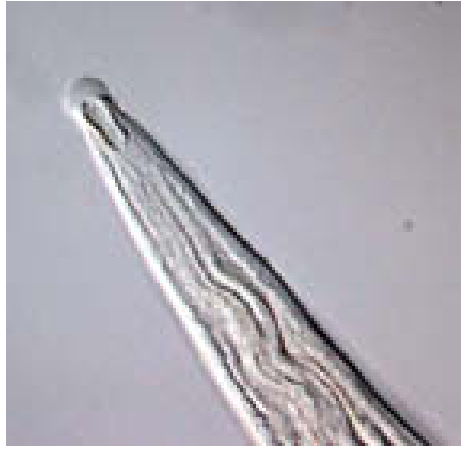
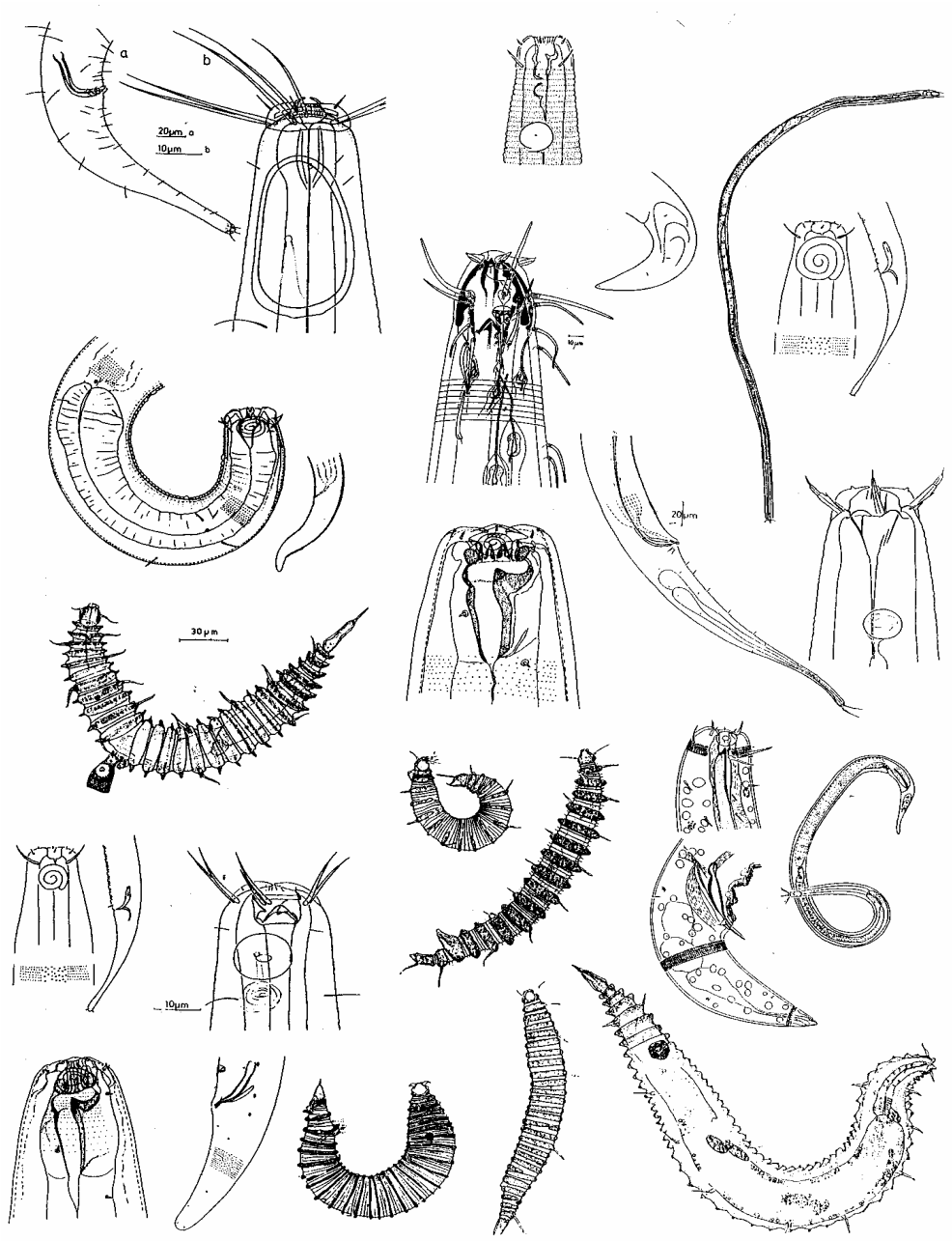
- Sample size ?
- Number of samples ? time and space
- Number of replicates ?
- location ? Time ?

Determinant factors : **size and life strategy of organisms**  
patchiness  
type of ecosystem - gradients



Meiofauna retained on sieve of 38  $\mu\text{m}$  (to 1 mm)





**Diversity in habitus and buccal morphology**

## Sampling



Qualitative

Semi-quantitative

Quantitative

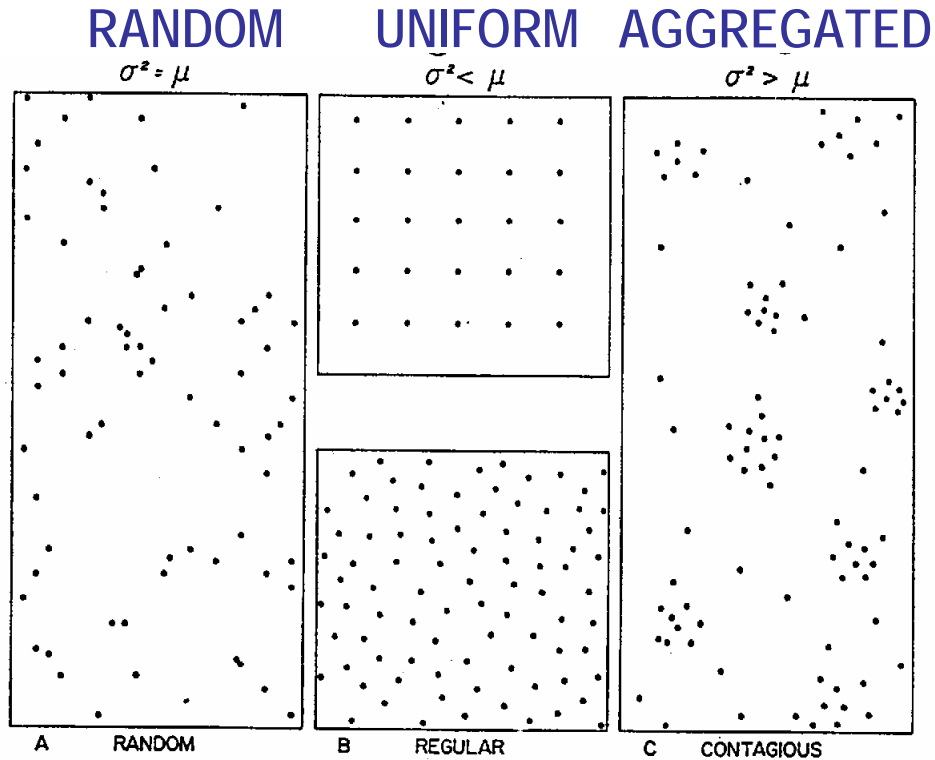
Per unit of surface or volume

### Ecological research

- Sample size ?
- Number of samples ? time and space
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Determinant factors : size and life strategy of organisms  
**patchiness**  
type of ecosystem - gradients

# Distribution patterns : " patchiness"



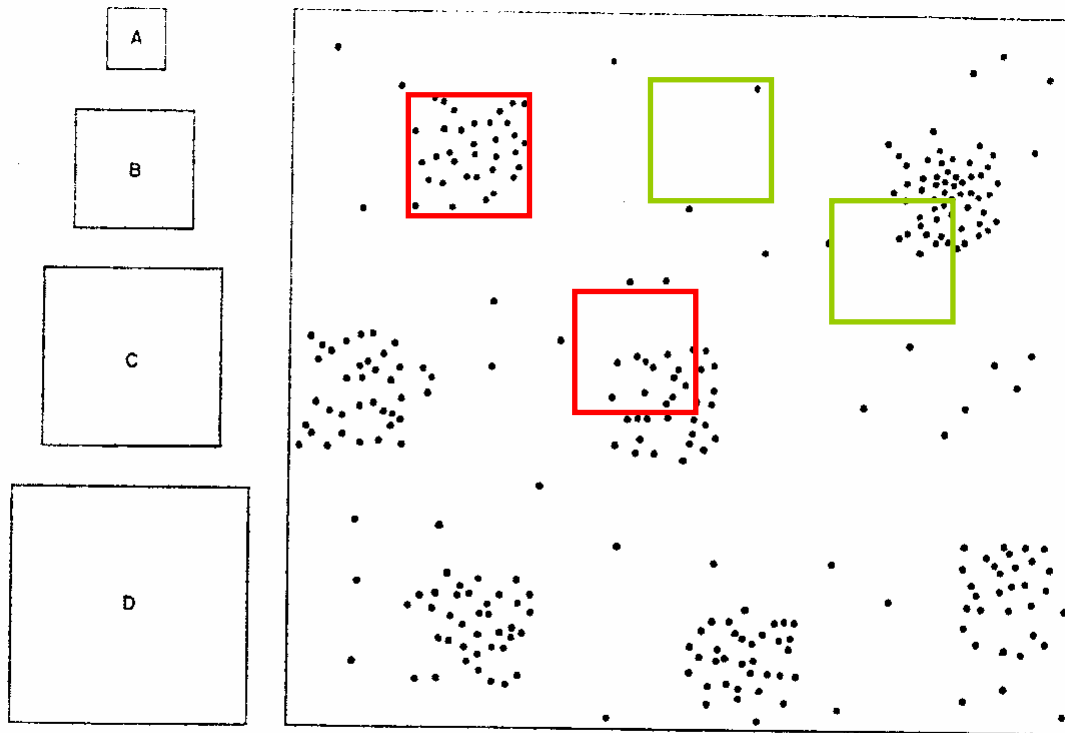
Variance      =      <      >      mean

Poisson      + binomial      - binomial

## Scale to investigate a population is important

overestimation

underestimation



A : random

B : aggregated

C : random

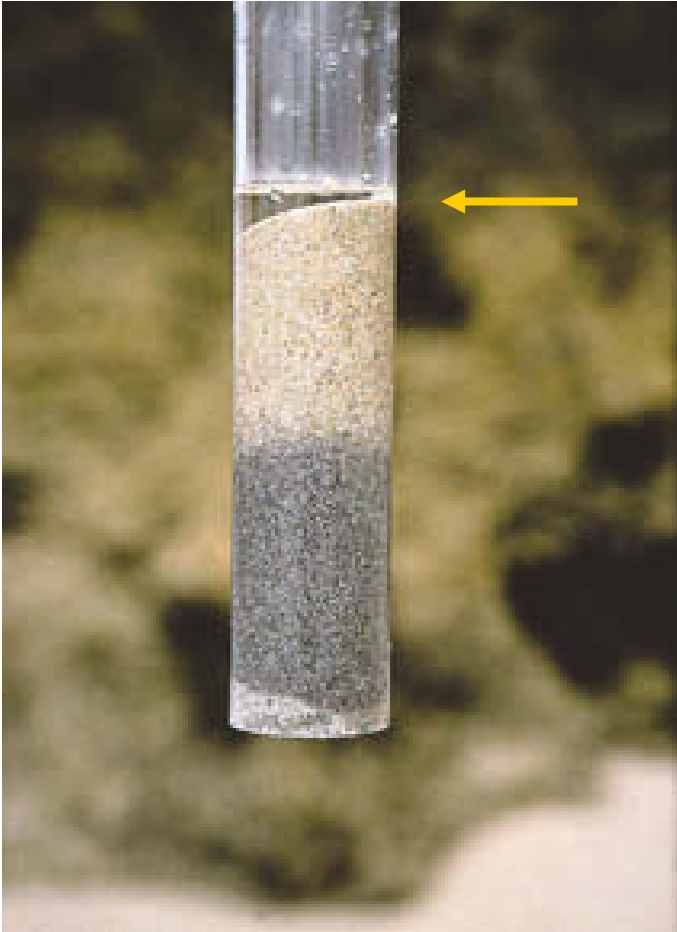
D : regular

FIGURE 14. Four quadrat sizes (A, B, C, D) and a contagious distribution with regularly distributed clumps.

Not always visual obvious=> correct sampling , counting and calculation of parameters is necessary



Cores of 10 cm<sup>2</sup> (3,5 cm in diameter)  
3 a 5 replicaten per site / station



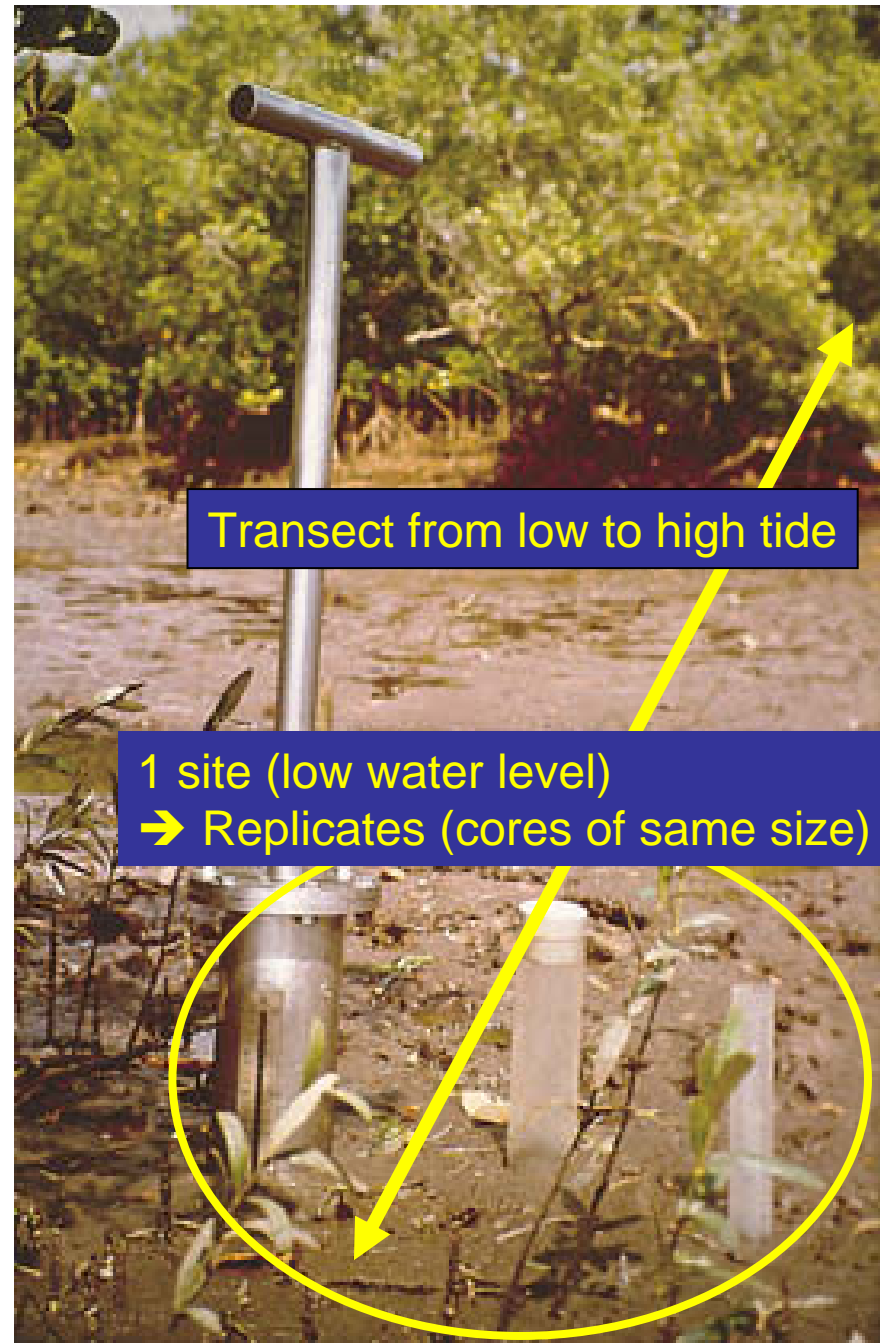
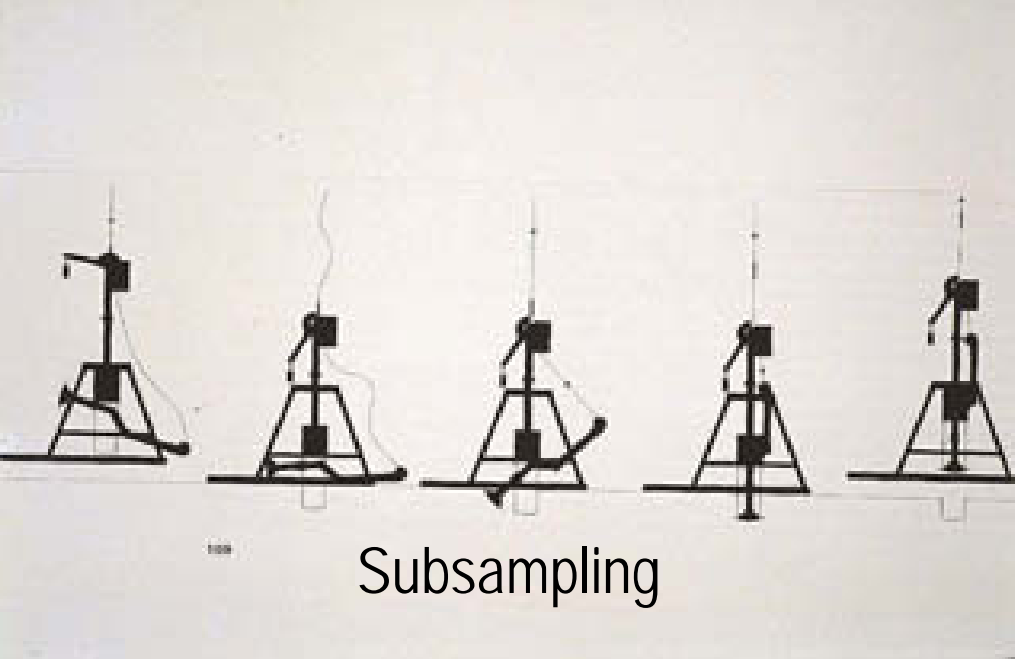
Overlying water → undisturbed  
Vertical in sediment → profile

Subtidal → boxcorer



Intertidal → hand cores





## Sampling



Qualitative

**Semi-quantitative**

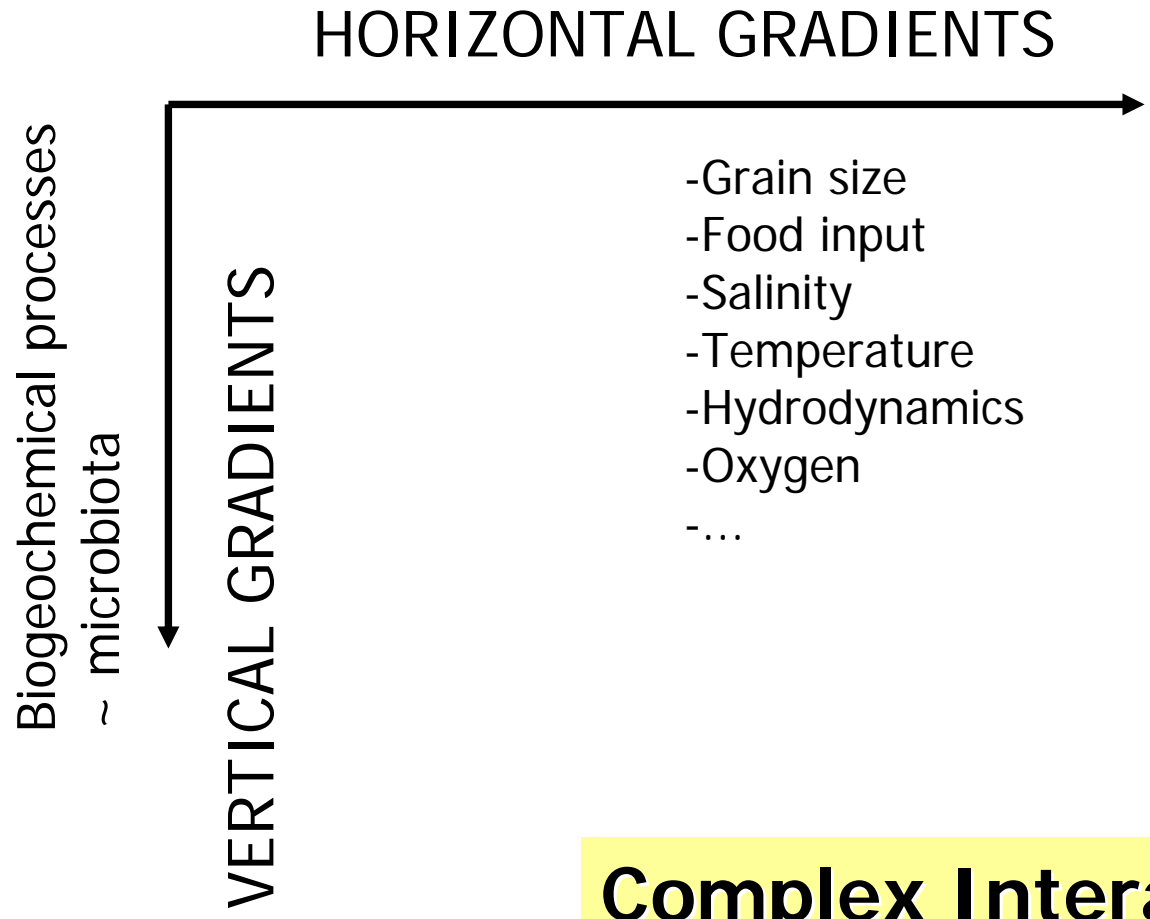
**Quantitative**

Per unit of surface or volume

### Ecological research

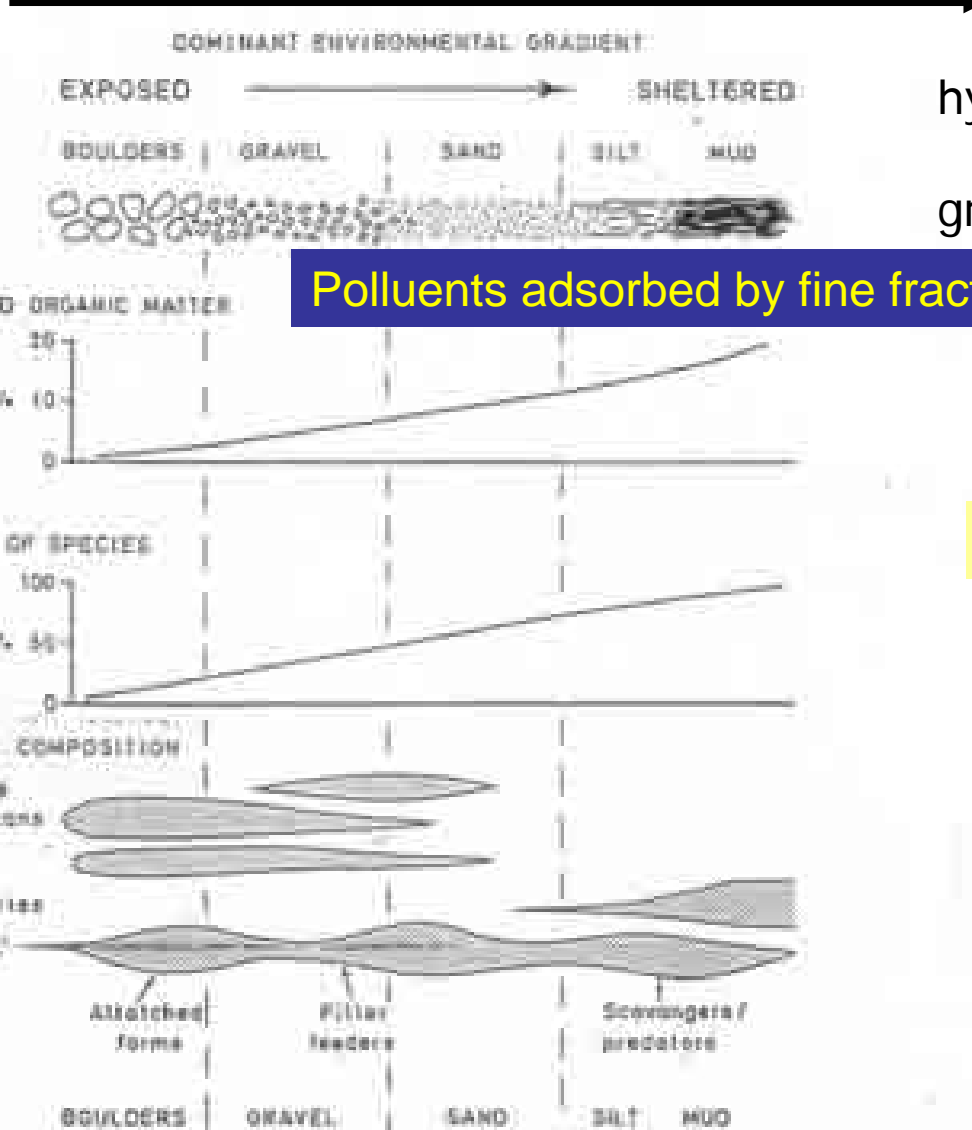
- Sample size ?
- Number of samples ? time and space
- Number of replicates ?
- location ? Time ?

**Determinant factors :** size and life strategy of organisms  
patchiness  
**type of ecosystem - gradients**



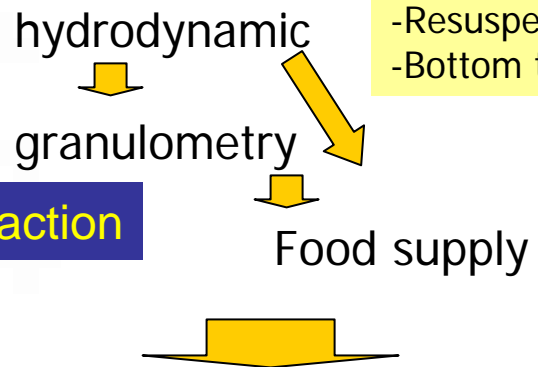
**Complex Interactions**

# HORIZONTAL GRADIENTS →



Pollutants adsorbed by fine fraction

- Sedimentation
- Resuspension
- Bottom transport



## Benthos

- diversity
- Taxonomical composition
- Trophic structure

Figure 150. The dominant environmental gradient associated with beaches is from exposure to shelter, evident in terms of grain size, organic matter, species numbers and diversity.

# Intertidal zonation

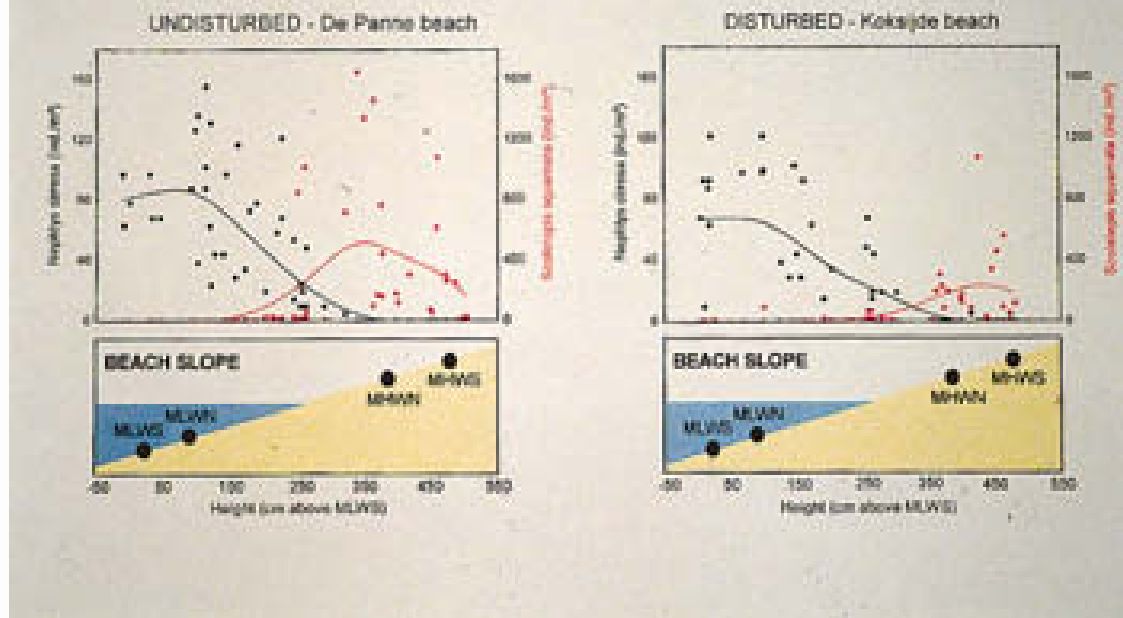
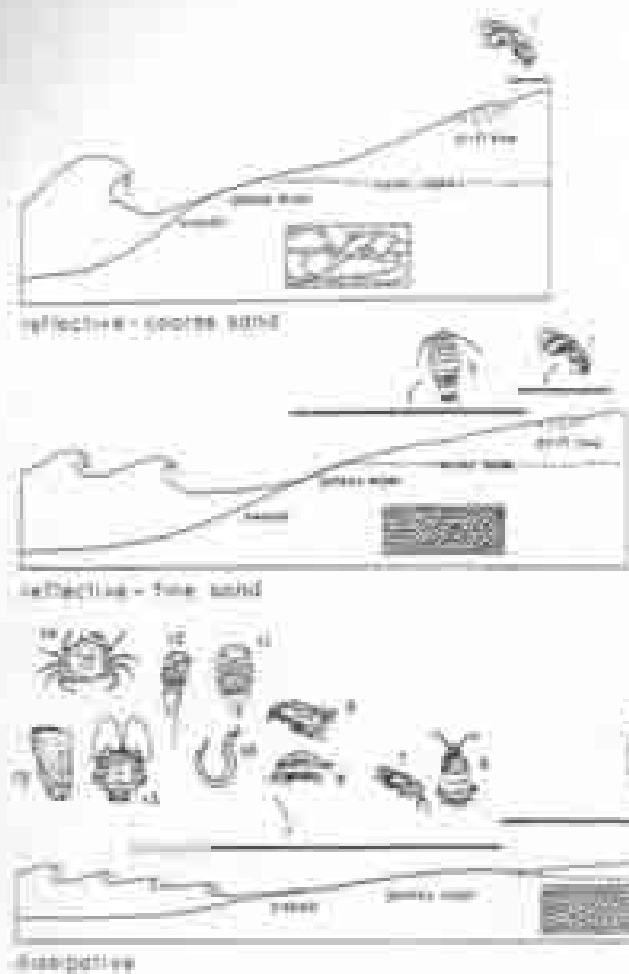


Figure 1. Diagrammatic representation of the zonation patterns of the intertidal macrofauna in sandy beaches of southern Chile (after Iannella et al., 1993). 1. *Glyceridae* *intercalaris* (Amphipoda); 2. *Eurytemora* *brachyura*; 3. *Diastylis* *brachyura*; 4. *Eurytemora* *modiol* (Isopoda); 5. *Phoronida* *ecornuta* (Cnidaria); 6. *Emerita* *ovalis* (Decapoda); 7. *Alpheoidea* *exilis*; 8. *Alpheo* *sp.*; 9. *Phoronida* *modiol* (Amphipoda); 10. *Alpheo* *impretus* (Phoronida); 11. *Maremma* *typica*; 12. *Chironomus* *plumosus* (Copepoda); 13. *Leptodora* *oblonga* (Amphipoda); 14. *Alpheo* *sp.* (Brachyura); and 15. *Maremma* *typica* (Isopoda).

# Salinity gradient

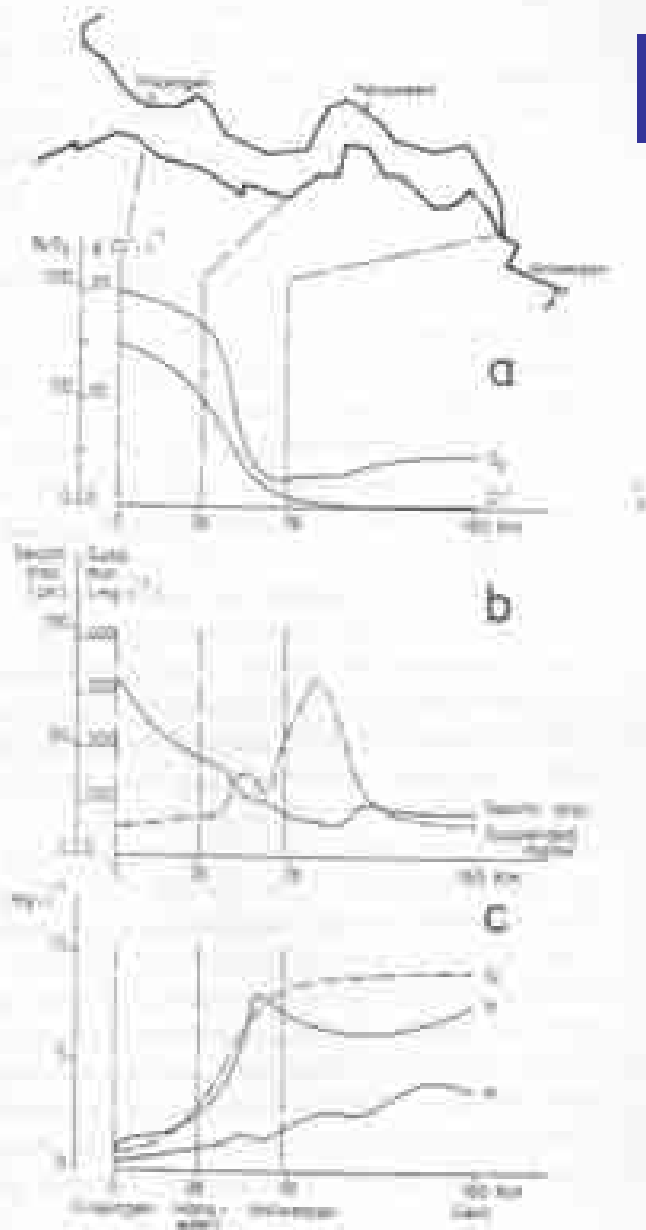
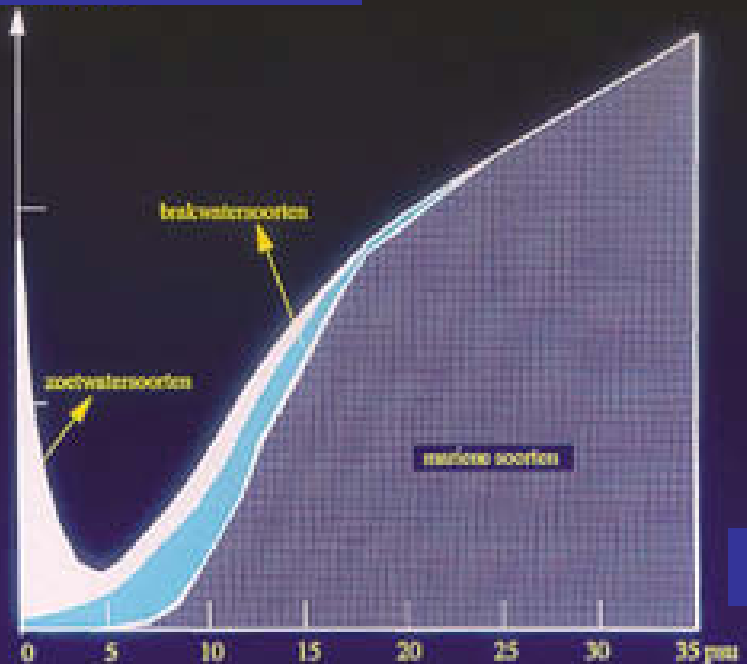


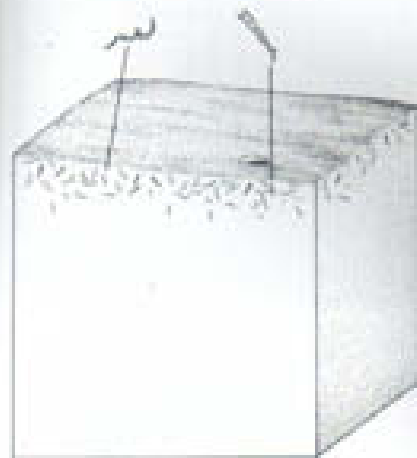
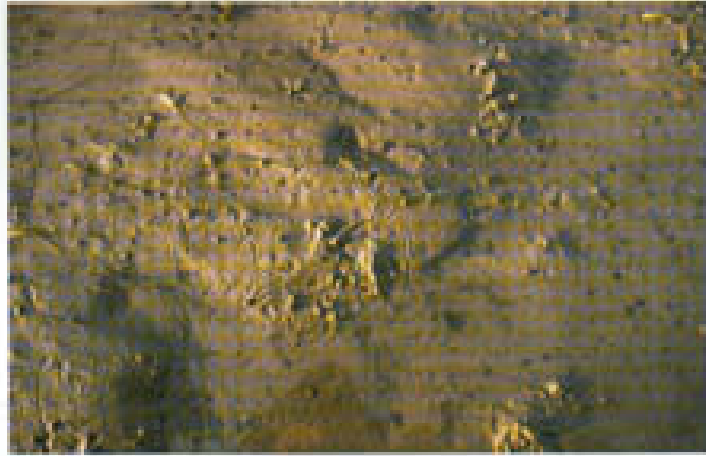
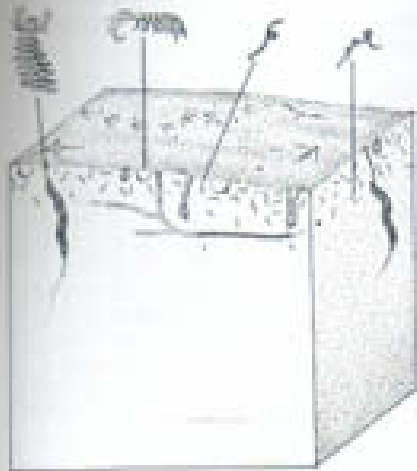
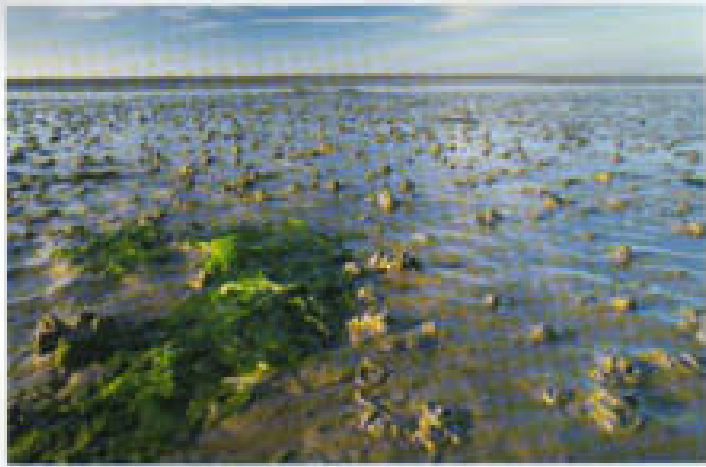
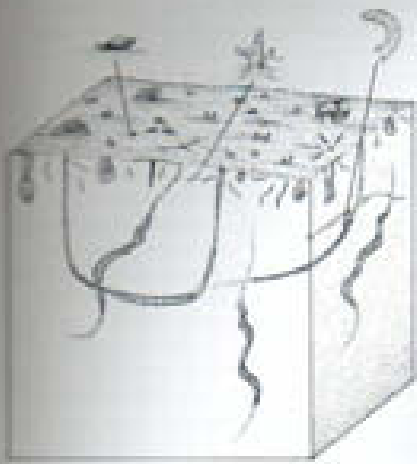
Fig. 4. Gradients in (a) salinity, oxygen, (b) nitrogenous species and nitrite, and (c) ammonium, nitrate and phosphate in the Wadden Sea estuary from Oost to Vlieland (Hansen *et al.* 1990).

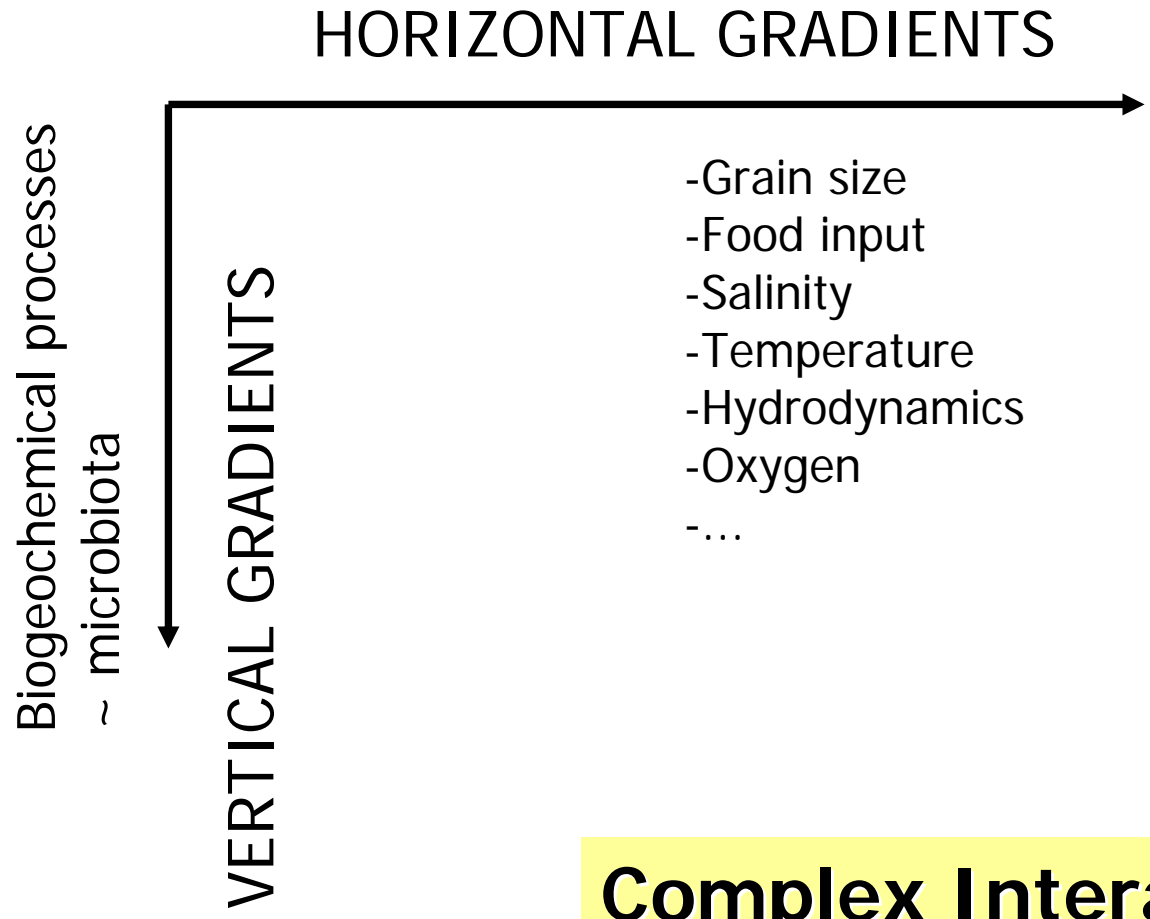
## Number of species



salinity







Biogeochemical processes  
~ microbiota

VERTICAL GRADIENTS

HORIZONTAL GRADIENTS

- Grain size
- Food input
- Salinity
- Temperature
- Hydrodynamics
- Oxygen
- ...

**Complex Interactions**

# Verticale profiles in **redox potential Eh** (mV) =

Electric charge by non-equilibrium between oxidation and reduction reactions in the sediment – dependent on the amount of available O<sub>2</sub>

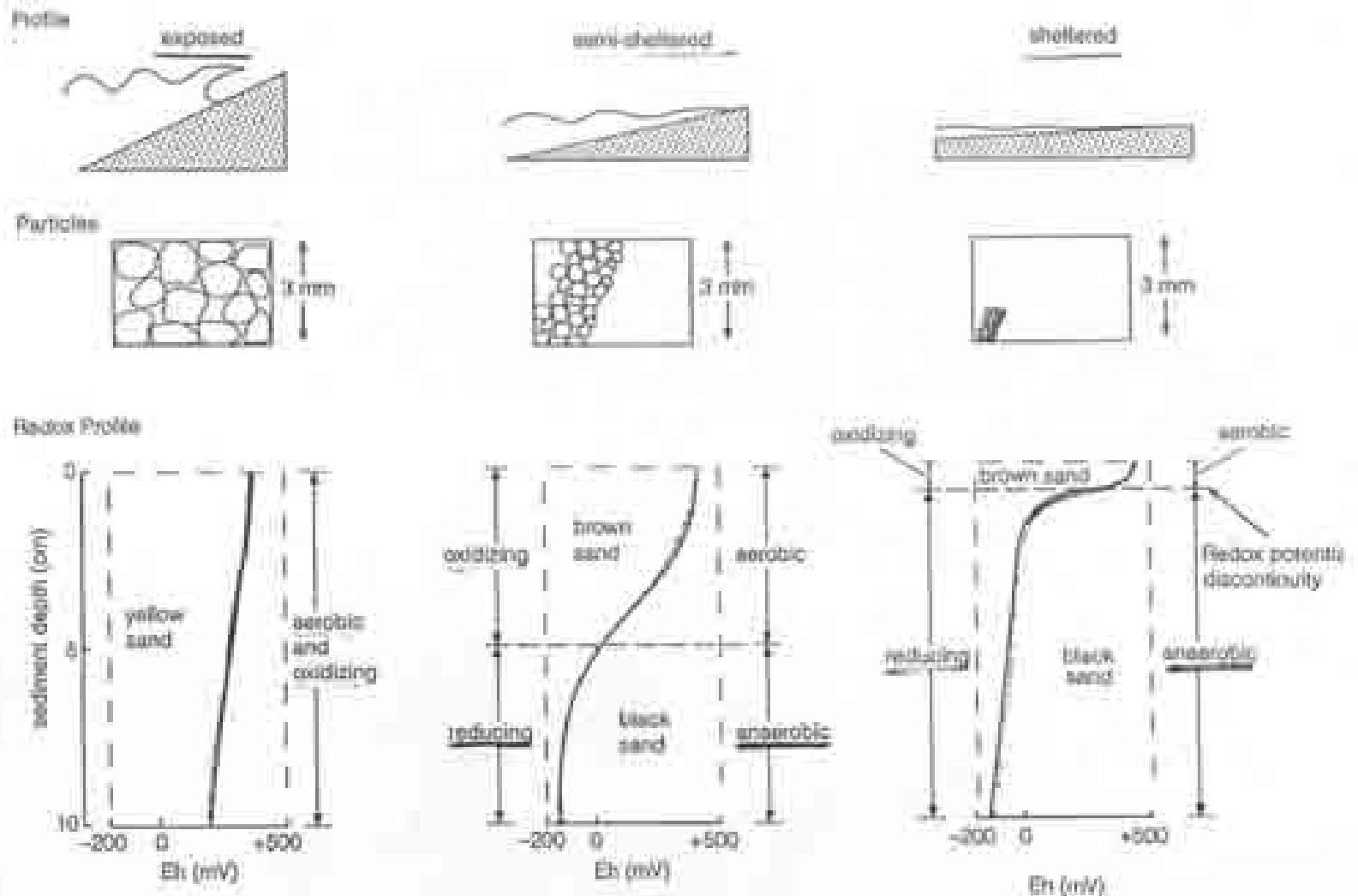


Fig. 1.14 Effects of exposure and particle size on sediment chemistry. Top, section through beach showing profile; middle, impression of size and arrangement of particles in beach; lower, redox profile through sediment column.

# RPD of redox potential discontinuity layer when oxidizing conditions shift to reducing conditions

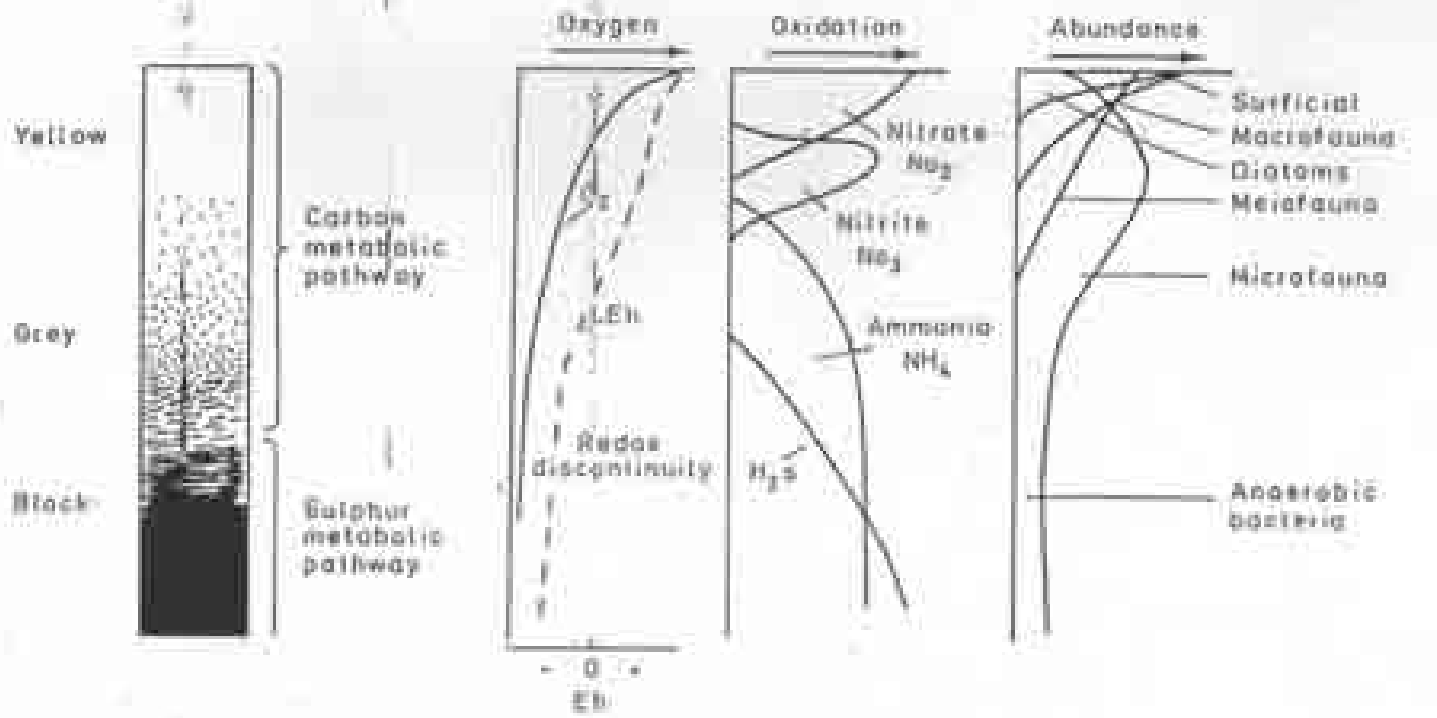
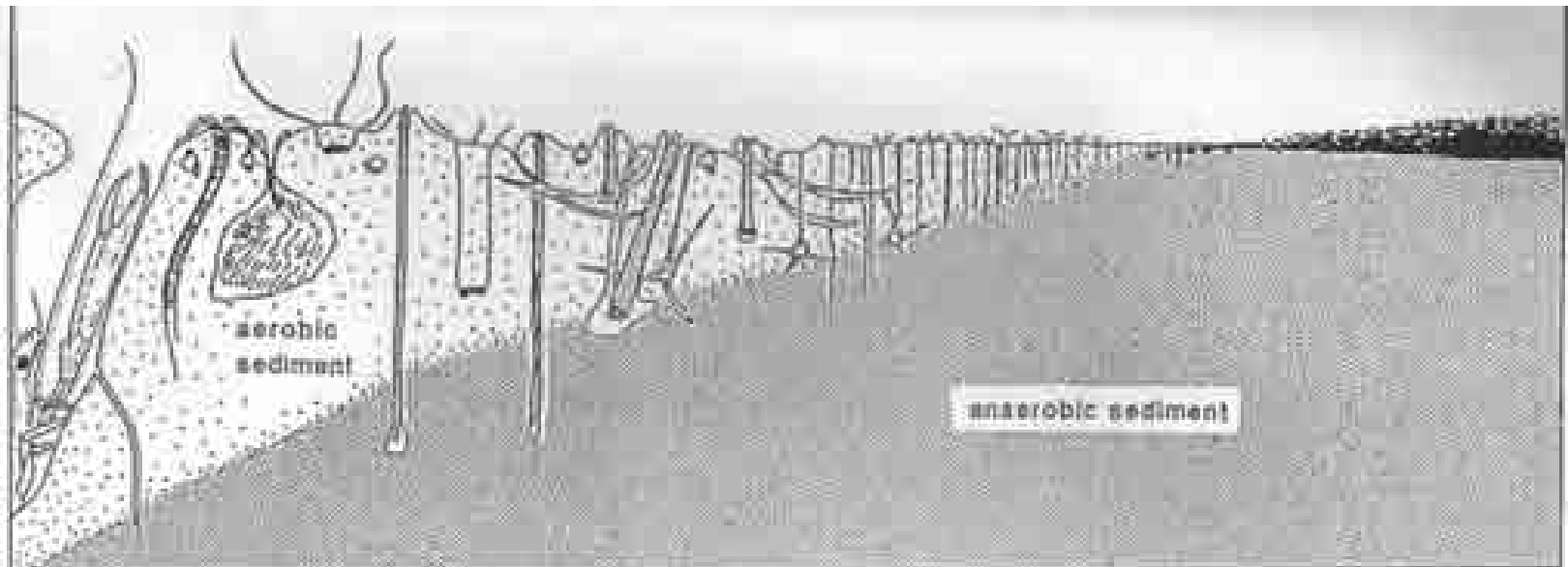


Figure 152. Vertical profile changes in sandy beach "soil" are a function of wave height, and are indicated by changes in colour, chemistry and floral and faunal composition. The switch from carbon to sulphur metabolic pathways is signalled by the absence of oxygen in the profile.

When deeper into the sediment, change from aerobic respiration to anaerobic respiration so that  $O_2$  as H acceptor is replaced by  $NO_3^- \rightarrow$  nitrate reduction or denitrification  $\rightarrow NH_4^+ \rightarrow N_2$  and  $SO_4^{2-} \rightarrow$  sulfate reduction  $\rightarrow H_2S$

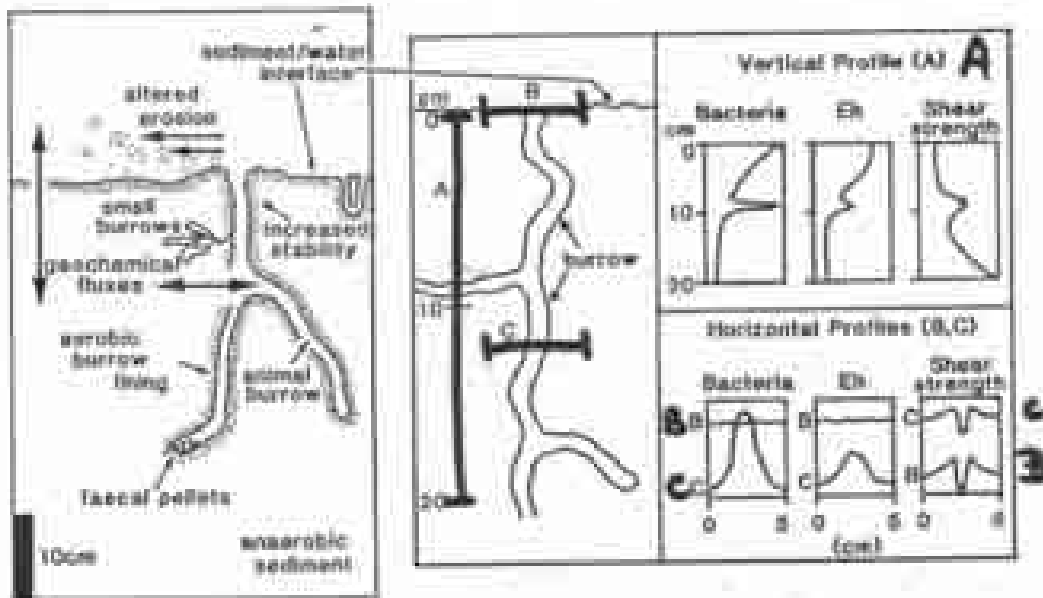
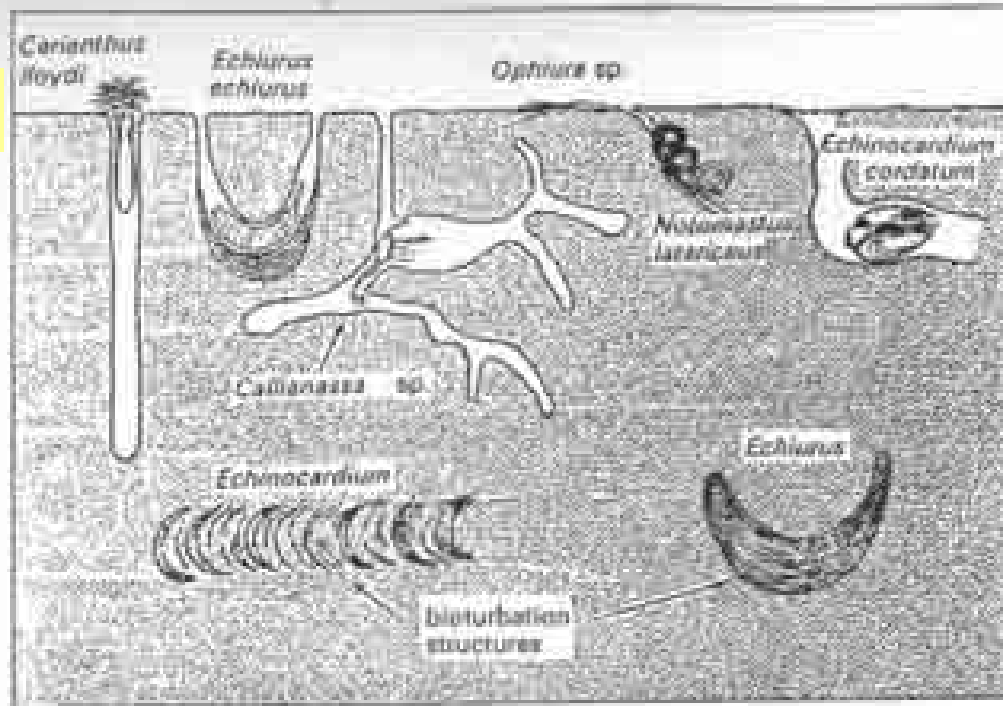
Finally even fermentation process  $\rightarrow$  methane



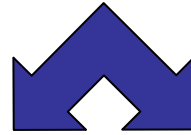
zone	normal	transitory		polluted	grossly polluted
typical macrofauna dominants	<i>Nucula</i> <i>Amphura</i> <i>Terebellides</i> <i>Rhodine</i> <i>Echinocardium</i> <i>Nephtys</i>	<i>Labidoplex</i> <i>Corbula</i> <i>Gonioda</i> <i>Thyasira</i> <i>Pholoe</i>	<i>Chaetocorn</i> <i>Anatides</i> <i>Pectinaria</i> <i>Mytilochela</i> <i>Ophiadromus</i>	<i>Capitella</i>  <i>Scoloplos</i>	no macrofauna surface covered by fibre "blanket"

Figure 11.5 Changes in benthic fauna and sediment oxygenation resulting from organic enrichment by paper mill pulp fibre. (From Pearson and Rosenberg, 1978.)

# Bioturbation



# Sampling



Qualitative

Semi-quantitative

Quantitative

Per unit of surface or volume

Ecological research

- Sample size ?
- Number of replicates ?
  - depending on variable to be measured
- Number of stations ? time and space
- location ? Time ?
  - to agree upon here and now

# Metadatabase

To collect information on sampling and processing in a datafile

Per site

- ID
- labelling
- Date of collection
- Co-ordinates (GPS)
- Description of habitat
- Components sampled
- Nr of replicates per component
- Name of collector
- Conditions of preservation
- Destination

Per sample

- ID
- labelling
- Date and time of collection
- Co-ordinates
- Conditions of sampling
- Sampling device
- Sample size
- Name of collector
- Conditions of preservation
- Destination

## → Field forms

- Date and time of processing
- Name – Institute
- Description of processing techniques





1 replicate or sample

Site or station

Low water line

What is needed now :

- A detailed sampling protocol for each variable

- A detailed sample processing protocol

- Forms to be filled in by sample collecting team in situ

Station number  
 Coordinates  
 Description habitat  
 Time  
 Name responsible

Example field form

variable	Measurement in situ	Number of replicates	Sampling device	Vertical profile	preservation
meiofauna	No	3 (?)	Core 10 cm <sup>2</sup>	no	8 % formol
macrofauna	No	3	Core 30 cm <sup>2</sup> (??)	no	8 % formol
salinity	32		Probe surface water	no	
Dissolved oxygen					
...					
....					
Dioxines		1	Core of ???	0-15 cm 15-30cm	frozen

Who is analyzing what ??

Name scientist	Name institute	variable
Dr Thanh	IEBR, Hanoi	meiofauna
.....		macrofauna
.....		Dioxine
		Heavy metals (which ???)
.....		Nutrients (Which ???)

# Database → end product of project

Metadatabase

Biodiversity database → taxonomy and ecology of benthic species

Biomonitoring database →

per station information on all biotic and abiotic variables measured  
to be provided by the stakeholders

Agreement on use and protection of data to be decided