

# Application of two modelling techniques for mapping distribution of perennial red alga *Furcellaria lumbricalis*

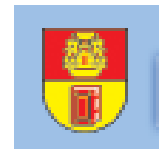
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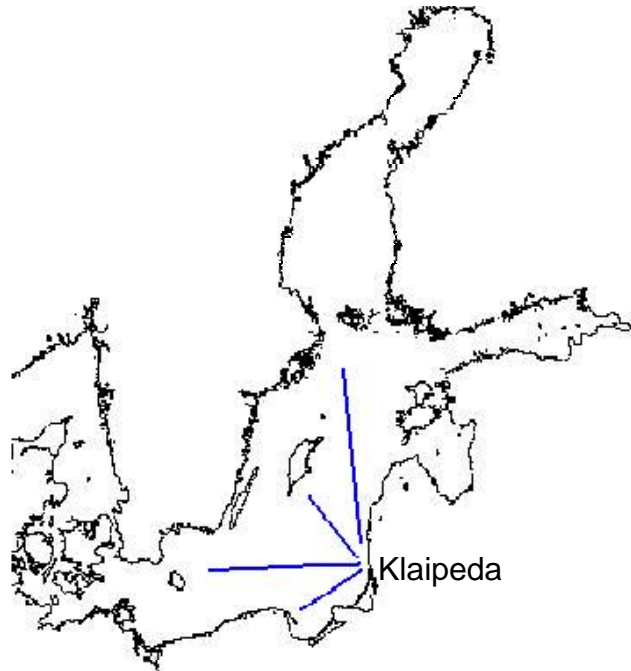
# SE Baltic coastal environment



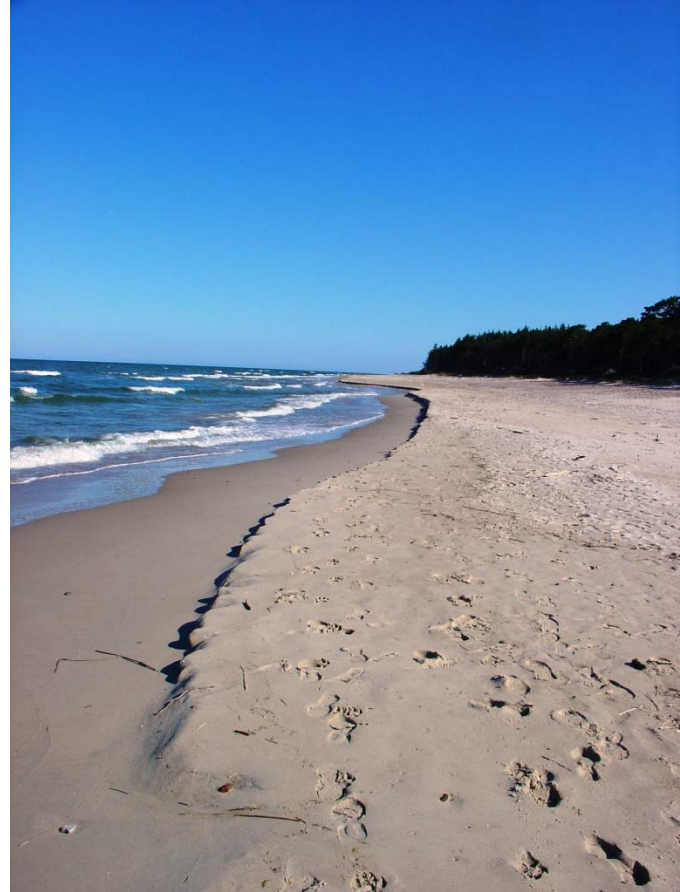
**Extreme environment...**



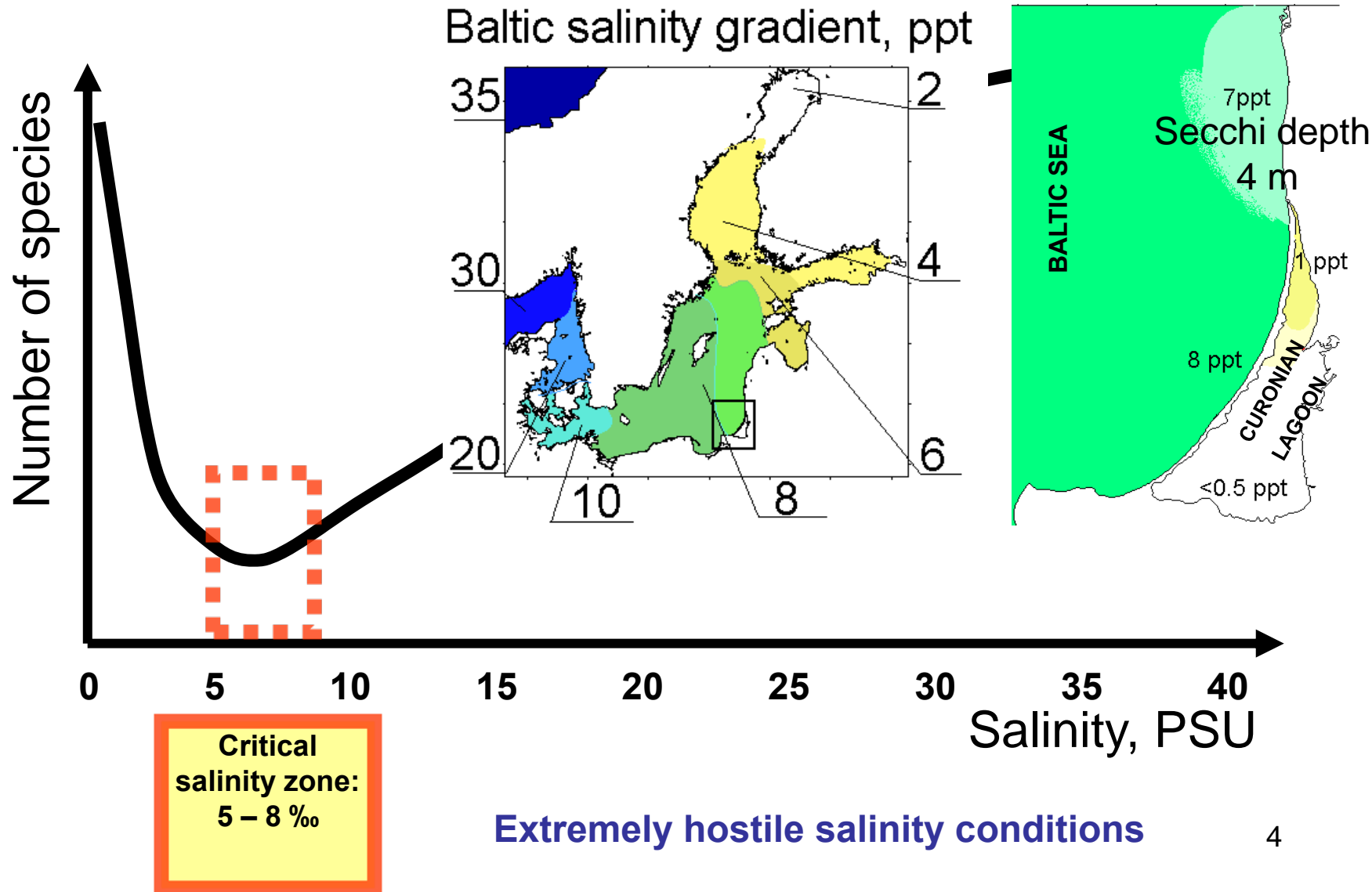
# SE Baltic coastal environment



- **Very exposed, wave fetch > 200 km,**
- **Maximum wave height  $\leq 8\text{m}$**
- **Active hydrodynamic, strong near-shore currents**
- **Straight coastline, no islands and inlets**

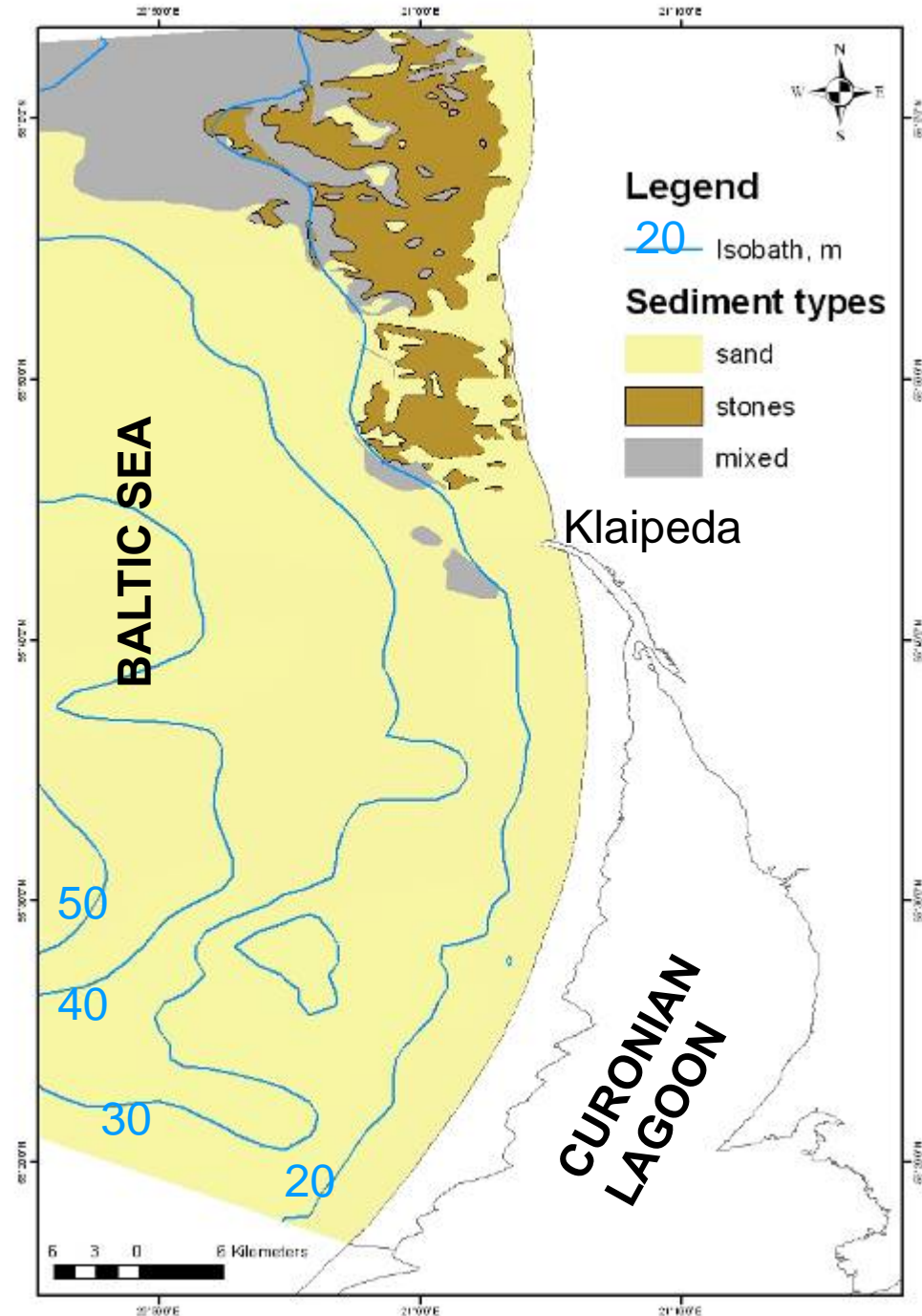


# Critical salinity zone or “*Artenminimum*” (Remane, 1934)



# Bottom sediments

- Mainly sand
- Moraine ridges
- Mixed bottoms (sand, gravel and stones) – very heterogeneous



# WHY the red alga *Furcellaria lumbricalis* (Huds.) Lamour ?



An embryo of the Baltic herring:  
its life begins in dense canopies  
of the benthic algae

# Research tasks

- **To assess the distribution patterns of *F. lumbricalis* at small and local coastal zone scale:**
  - Small = cm to m
  - Local coastal zone = hundreds of m to km
- **To develop predictive models**
- To produce the recent distribution map and assess the stock of *F. lumbricalis*

# Methods

## Remote underwater video camera

- **Two digital cameras**
  1. Black and white (sensibility 0.05 lx)
  2. Colour (sensibility 7 lx)
- **Depth sensor and GPS**
- **400 Wt light**
- **Two lasers indicating a 10 cm scale**
- **150 m cable, connecting the cameras with the control unit onboard**
- **Control unit and digital recorder**



# Field methods:

▲ Remote underwater video

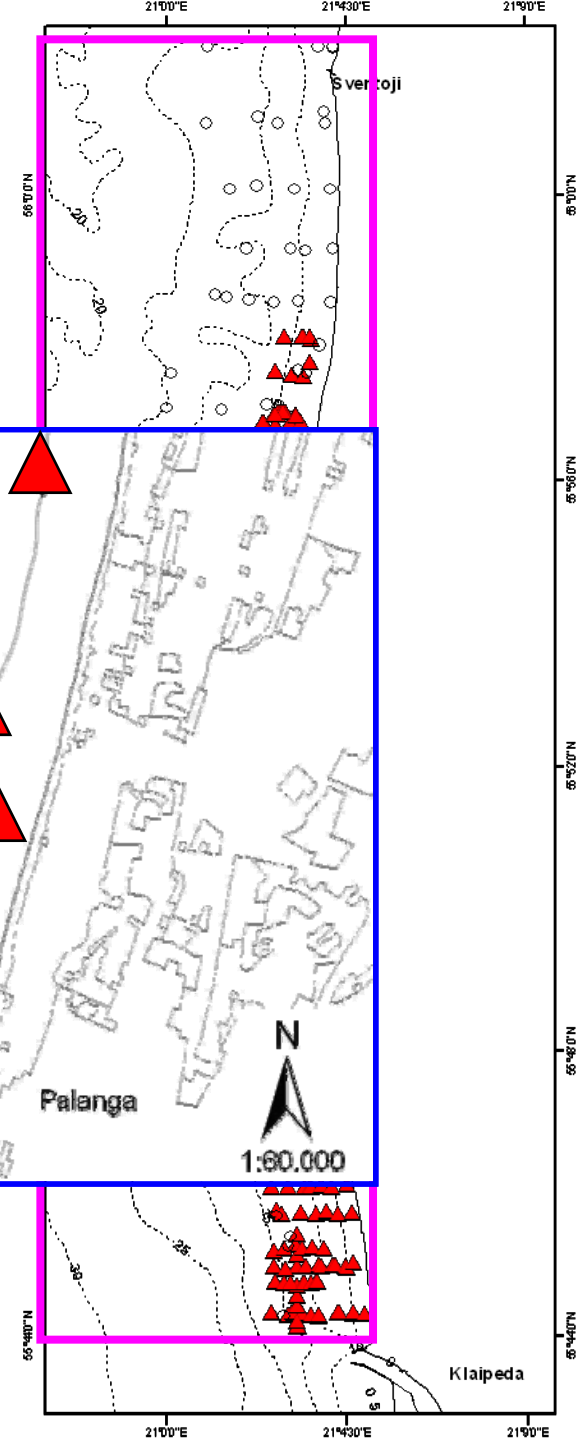
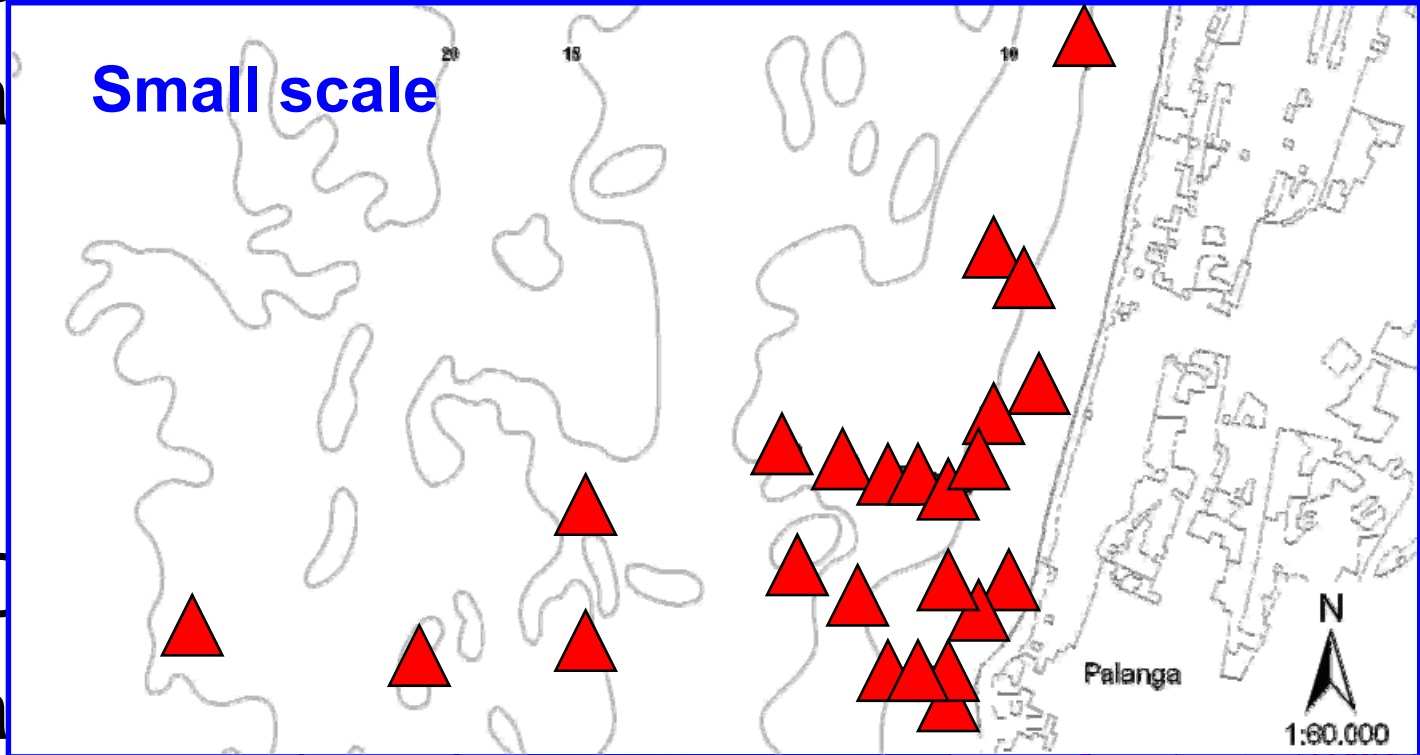
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Small scale

o SC

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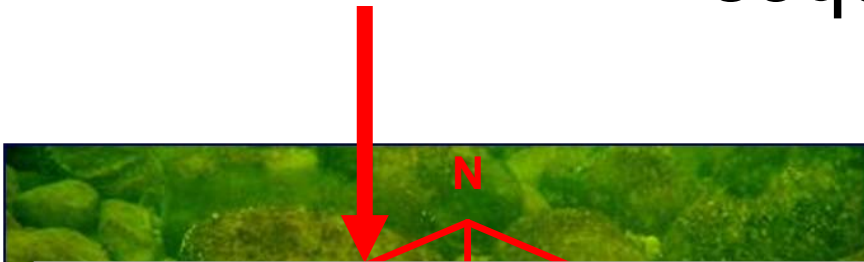
Local coastal zone scale



Klaipeda

# Small scale analysis:

deriving quantitative data from a video stills sequence



1. Depth (sensor)
2. Type of substrate
3. Surrounding bottom sediment

Table 1. List of parameters derived from the video analysis.

Parameter name and abbreviation	Description	No. of samples
Mobility of surrounding bottom sediments (MSBS)	mobile (>70% sand, gravel, pebbles, cobbles)	1025
	stable (>70% small and large boulders)	
	intermediate (~50% mobile and ~50% stable bottom types)	

- ... other parameters

# Local coastal zone scale modelling method

- Generalized regression analysis and spatial prediction for R v2.0 (GRASP)
- Response variables:
  - occurrence of *F. lumbricalis* (1/0)
  - % cover of *F. lumbricalis*

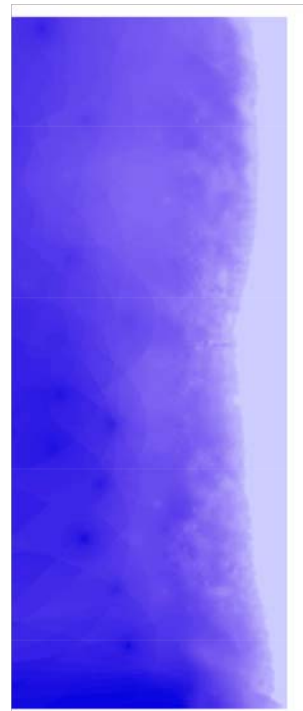
# Local scale modelling methods

- Environmental (predictors) variables:

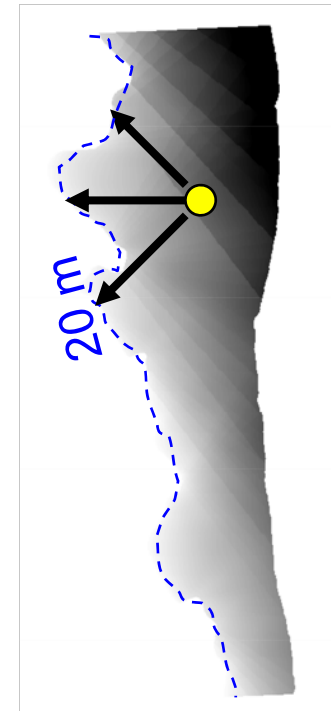
Occurrence of  
hard substrate



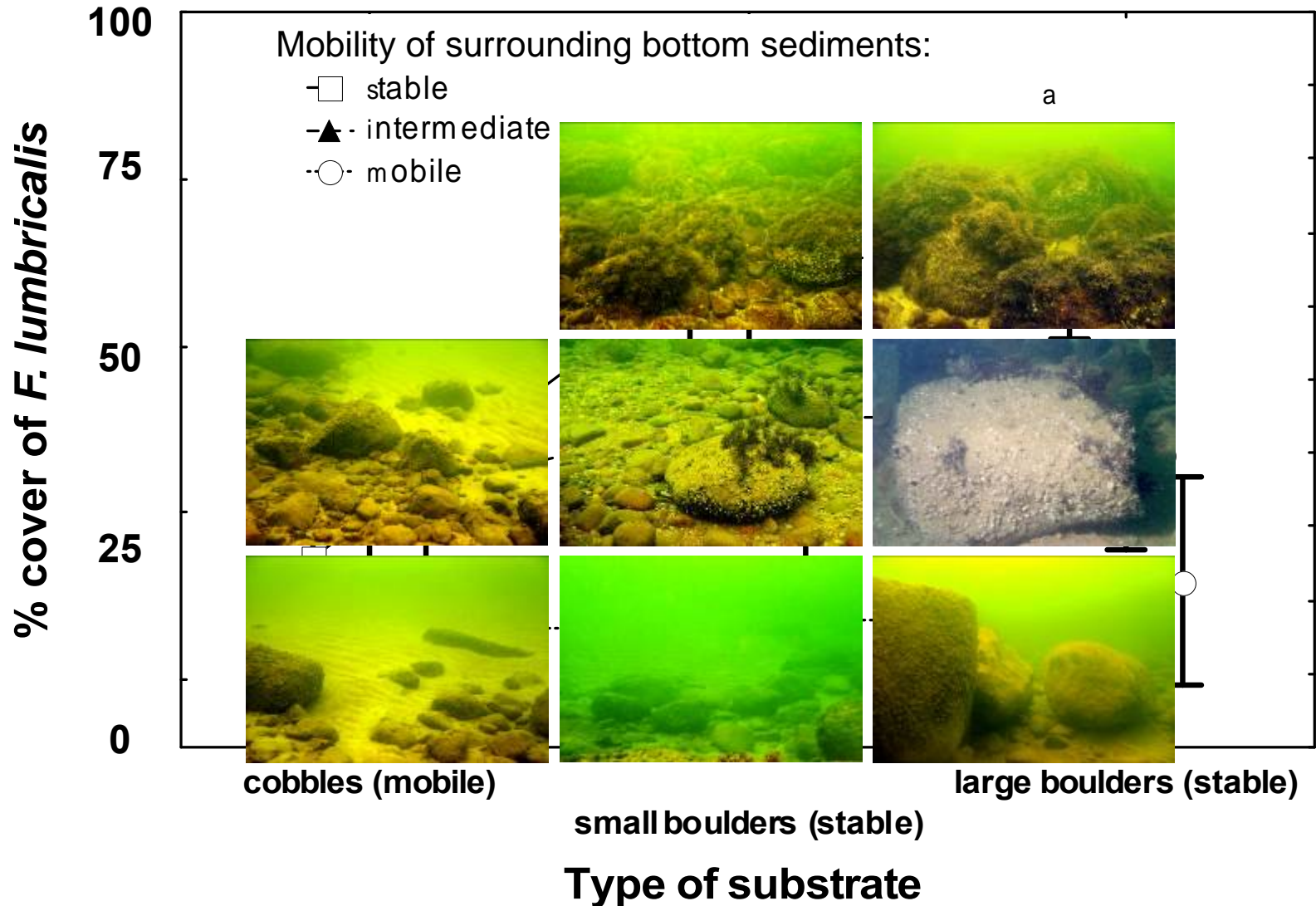
Bathymetry



Wave exposure  
(proxy)

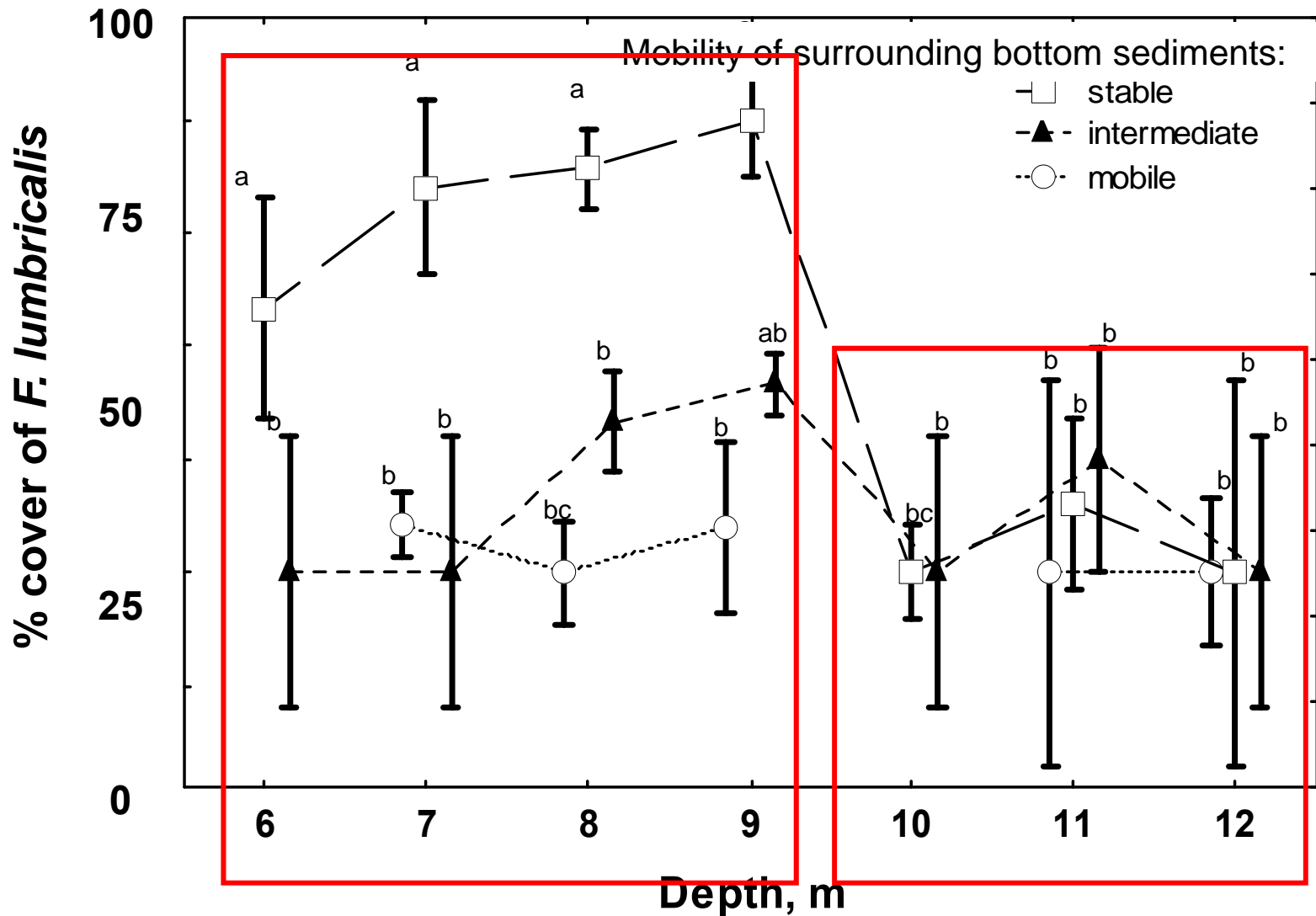


# Results: local scale



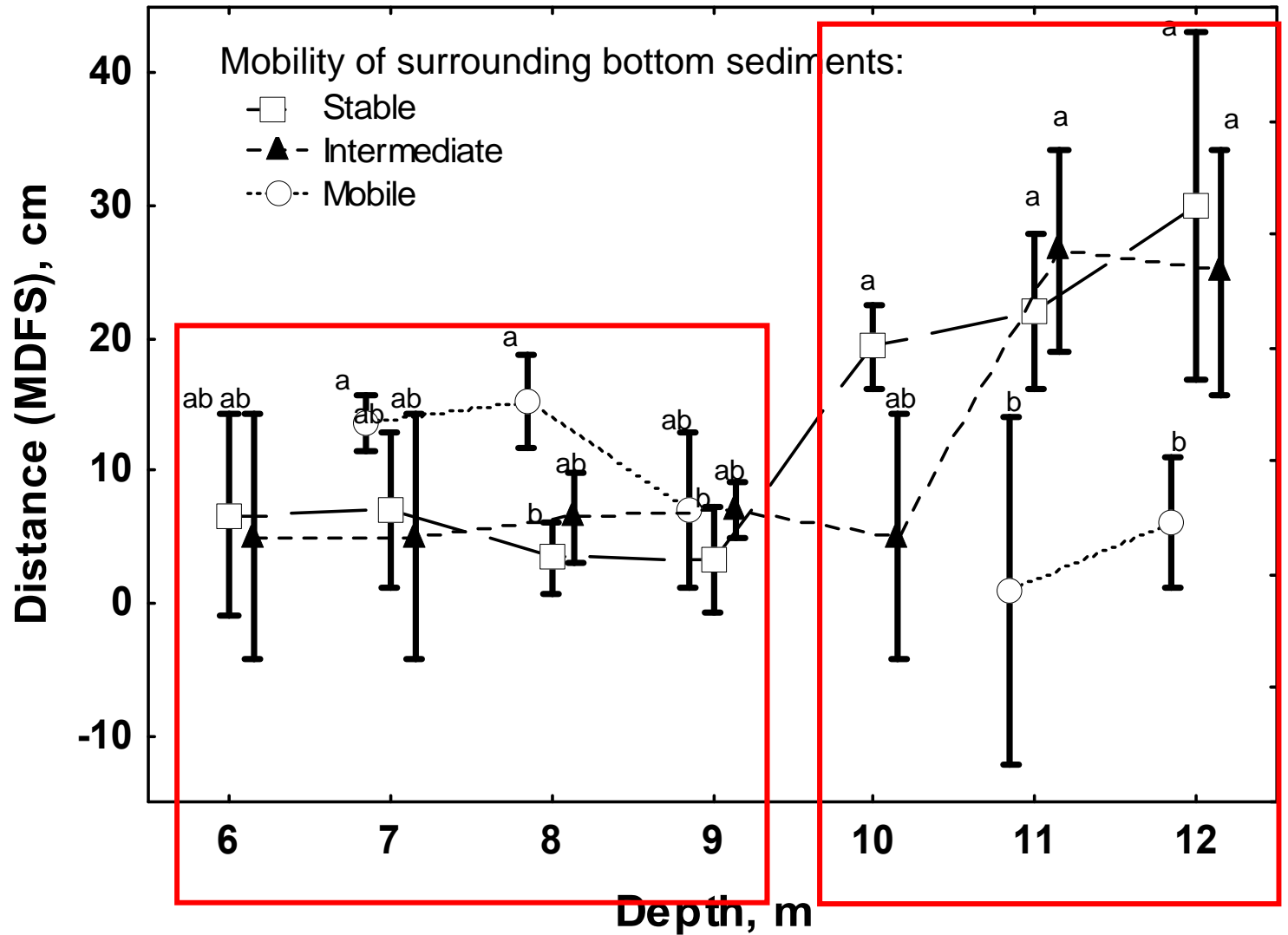
The mean cover of *F. lumbricalis* on different substrate types (CFS) within mobile, intermediate and stable surrounding bottom sediments

The letters above indicate homogeneous groups of Tukey's HSD test (N= 90, Mean  $\pm$ 0.95 Conf. intervals)



The averaged total coverage of *F. lumbricalis* (TCF) on different types of surrounding bottom sediments along the depth gradient

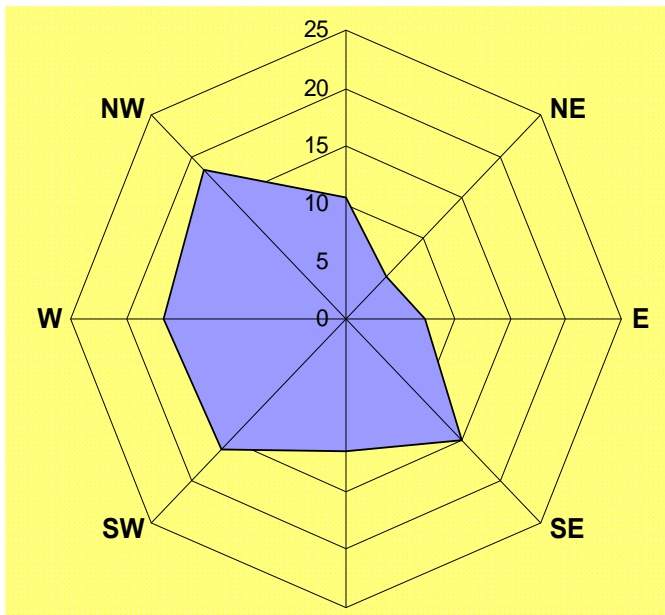
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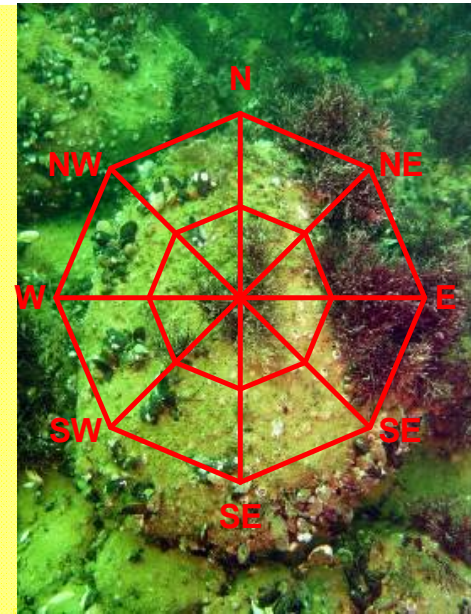
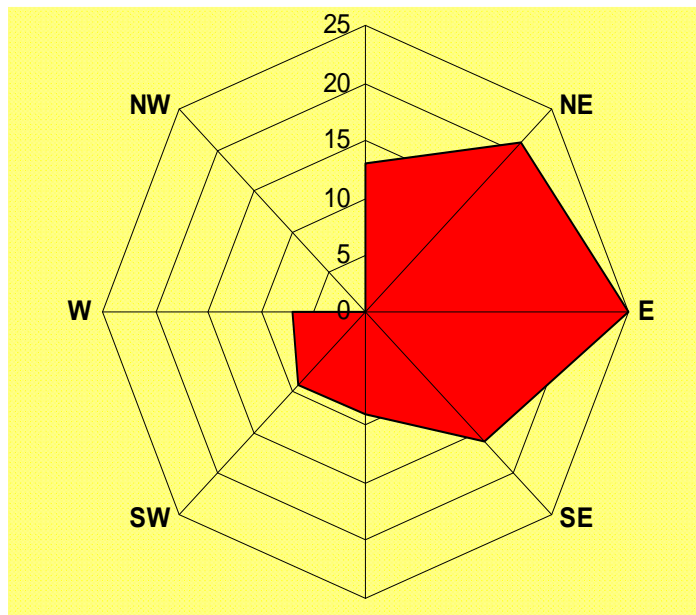
The minimum distance between the seabed and holdfast of *F. lumbricalis* on substrate (MDSF) on different types of surrounding bottom sediments along the depth gradient

# Distribution of *F. lumbricalis* correlation with frequency of waves direction

## Frequency of stormy wave directions



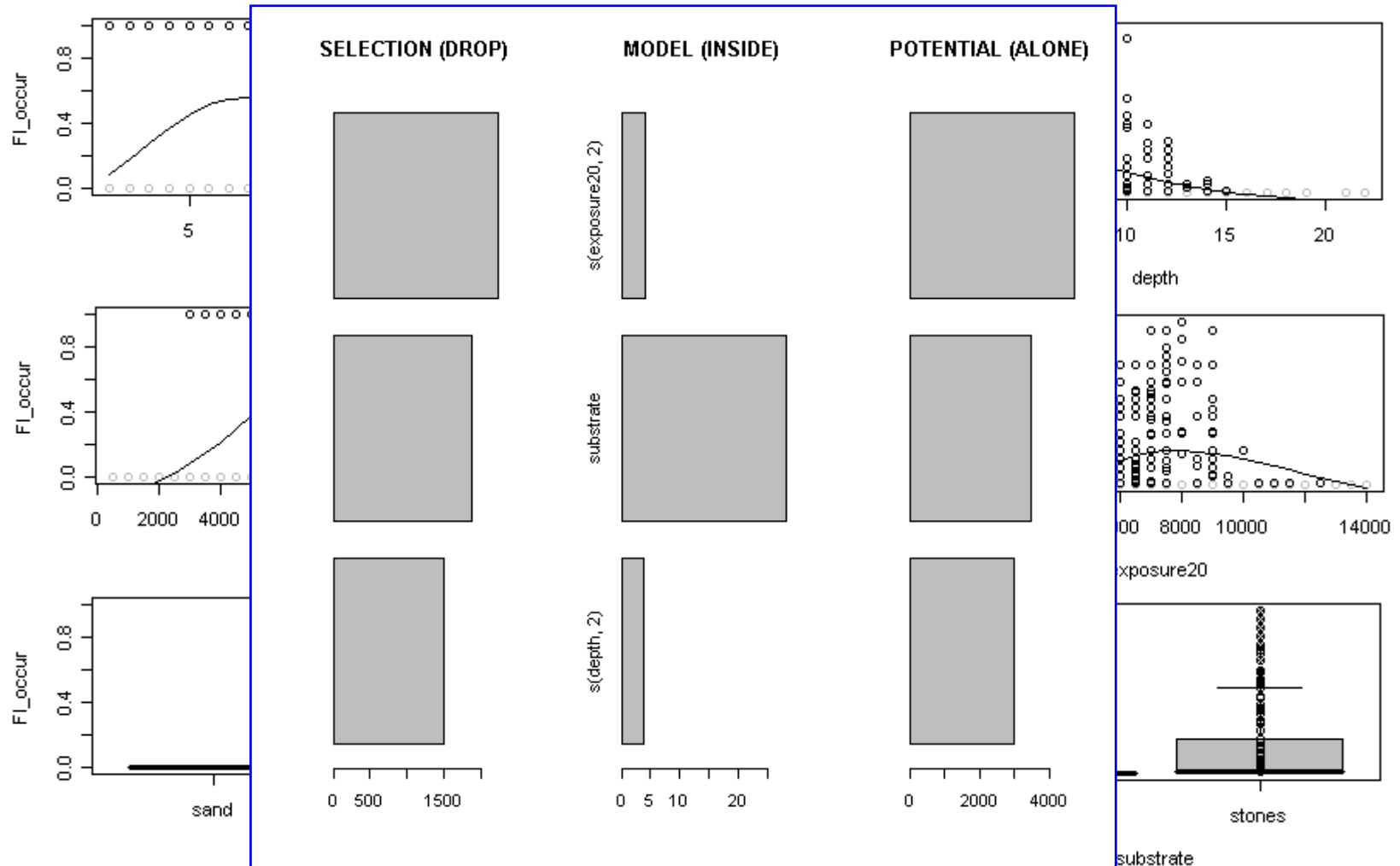
## Occurrence of *F. lumbricalis* on different sides of stones



**Significant negative rank correlation ( $\rho = -0,89$ ,  $p < 0.05$ )**

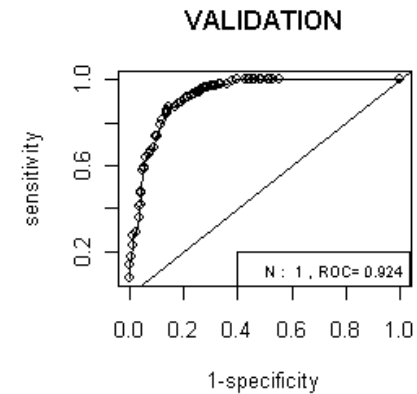
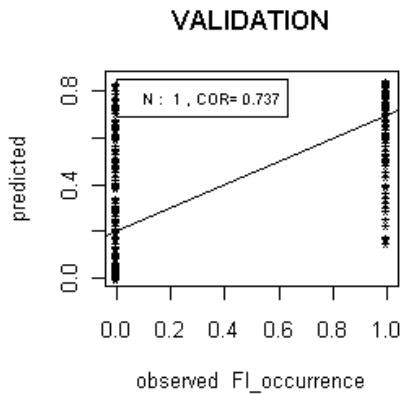
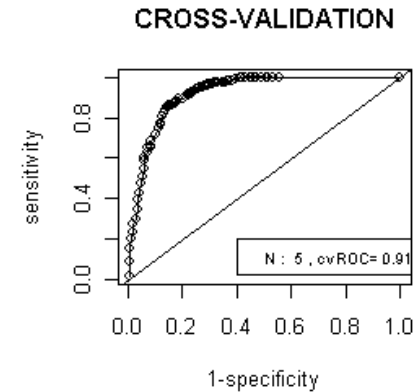
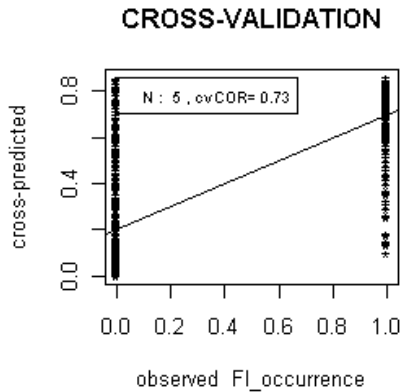
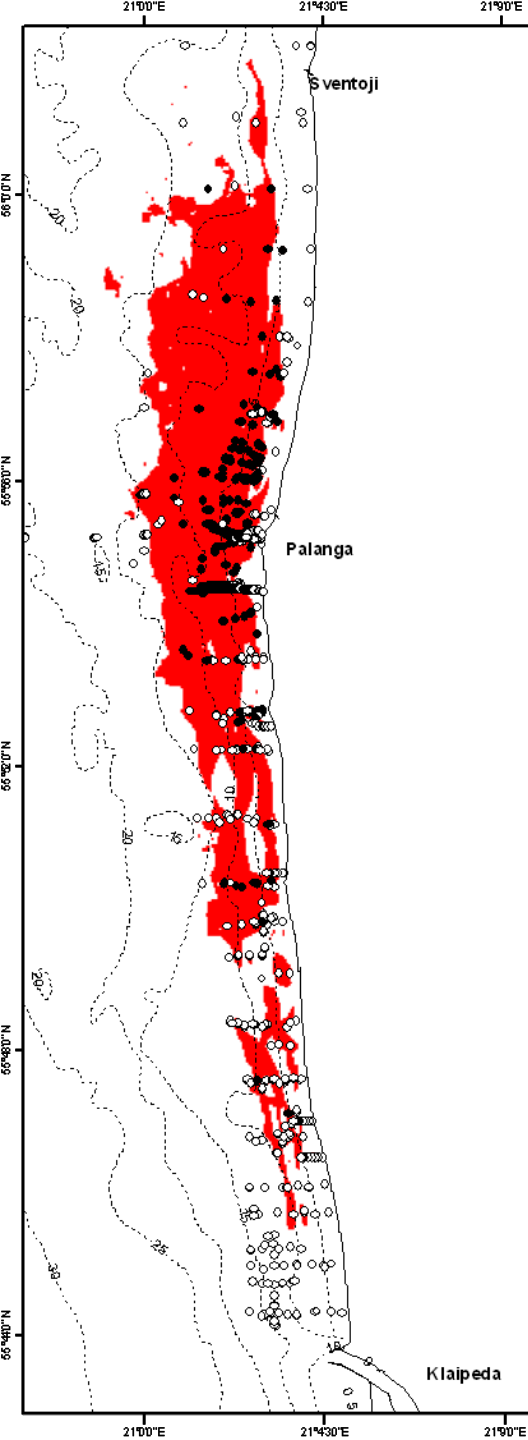
# Results: local coastal zone scale

Model of occurrence of *F. lumbricalis*      Model of cover of the alga



# Results: local coastal zone scale

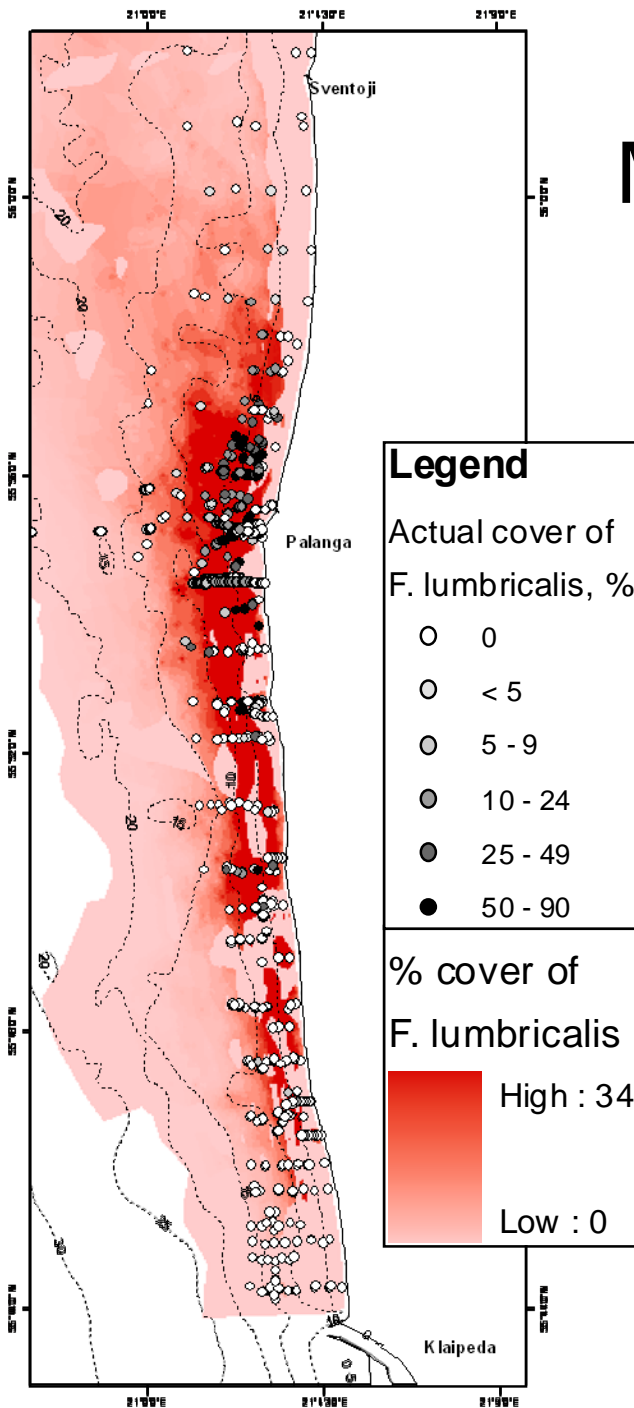
- Modelled occurrence of *F. lumbricalis*
- True occurrence of *F. lumbricalis*
- True absence of *F. lumbricalis*



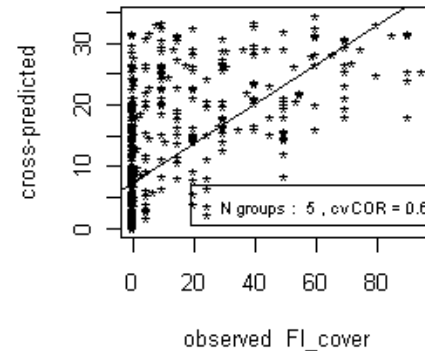
The model explains 80 % of variation

# Results: local coastal zone scale

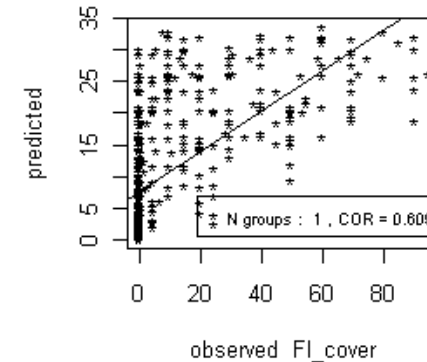
## Modelled cover of *F. lumbricalis*



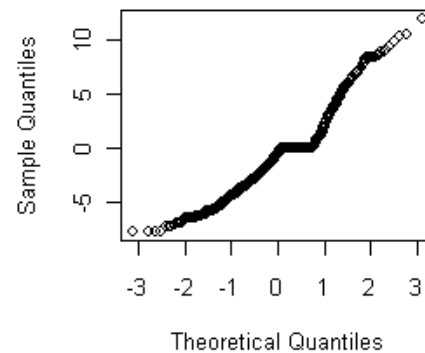
CROSS-VALIDATION



VALIDATION



RESIDUALS: fitted values



The model explains 40 % of variation

# CONCLUSIONS

- ❖ **At the small scale (cm to m) the distribution pattern of *F. lumbricalis* is shaped by the frequency of stormy wind direction and mobility of the surrounding bottom**
- ❖ **At the local coastal zone scale (hundreds of m to km) the distribution of *F. lumbricalis* is determined by the occurrence of suitable substrate, wave exposure and bathymetry**
- ❖ **The obtained models at different spatial scales are applicable for the prediction of *F. lumbricalis* distribution, however predictions are highly dependent on the quality (e.g. resolution) of the input data such as sediments & bathymetry**

# Acknowledgements

- **Andrius Šiaulys, Aleksej Šaškov, Jūratė Lesutienė, Anastazija Zaiko, Viktoras Didžiulis and Mindaugas Žilius (from Coastal Research and Planning Institute, Klaipėda University, Lithuania), Jouni Leiniki, Juho Vuolteenaho (from ALLeco, Finland) and Triin Reitalu (from Estonian Marine Institute, Estonia).**
- **This research was supported by:**
  - **the EU FP6 project MARBEF (GOCE-CT-2003-505446),**
  - **EU Life Nature “Marine Protected Areas in the Eastern Baltic Sea” (LIFE05NAT/LV/000100)**
  - **The EU BONUS + project PREHAB “Spatial PREdiction of benthic HABitats in the Baltic Sea: incorporating anthropogenic pressures and economic evaluation” (BONUS-163)**

A photograph of three men on a boat, focused on a control panel. The man on the left is shirtless and wearing a white Nike cap. The man in the middle is wearing a red t-shirt and sunglasses. The man on the right is wearing a white pinstriped shirt and glasses. They are all looking down at a control panel that features a yellow emergency stop button and a digital display. The background shows a body of water and a distant shoreline under a clear blue sky.

**THE END**