



# **Sediment and biota monitoring of an offshore dredged material disposal site in the German Bight**

## **Assessment by means of the OSPAR-criteria**

Uwe Hentschke<sup>1</sup>, Sabine Schäfer<sup>1</sup>, Birgit Schubert<sup>1</sup>

Maja Karrasch<sup>2</sup>

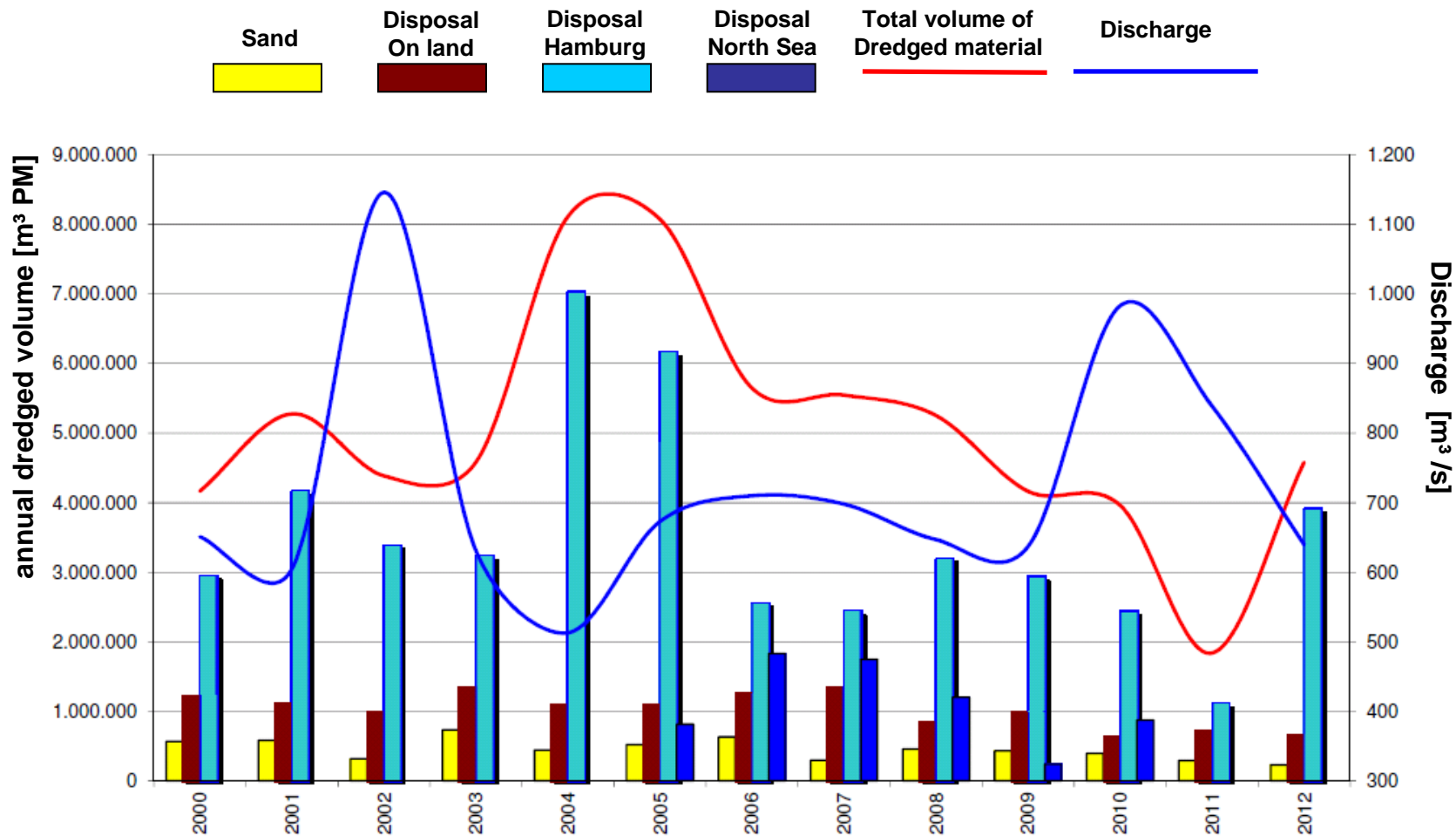


<sup>1</sup>Federal Institute of Hydrology, Germany

<sup>2</sup>Hamburg Port Authority, Germany

# Development of dredged material amount

*Hamburg harbour and River Elbe (2000-2012)*



## Measures to reduce dredging quantities

- River engineering measures
  - redesign of Elbe side arms
  - creation of flooding areas
  - underwater deposition areas
- Sediment traps
- Reduction of sedimentation
  - current deflecting walls (CDF)
  - **Removal of sediment out of system**



- **GÜBAK:** Joint Transitional Arrangements for the Handling of Dredged Material in German Federal Coastal Waterways

## *National implementation of OSPAR convention*

- **Mutual agreement** between Hamburg Port Authority and the Federal State of Schleswig-Holstein

## *28 conditions for permitting disposal*

- Establishment of a **monitoring concept**
- Assessment according to national regulations
- Assessment according EAC
- No disposal of material
  - characterized by high ecotoxicities (5 or 6)
  - expecting bioaccumulation effects
  - significant higher polluted in comparison to reference period



## Investigations of the dredging area

- Sediment/ Ecotoxicology/ Contaminants

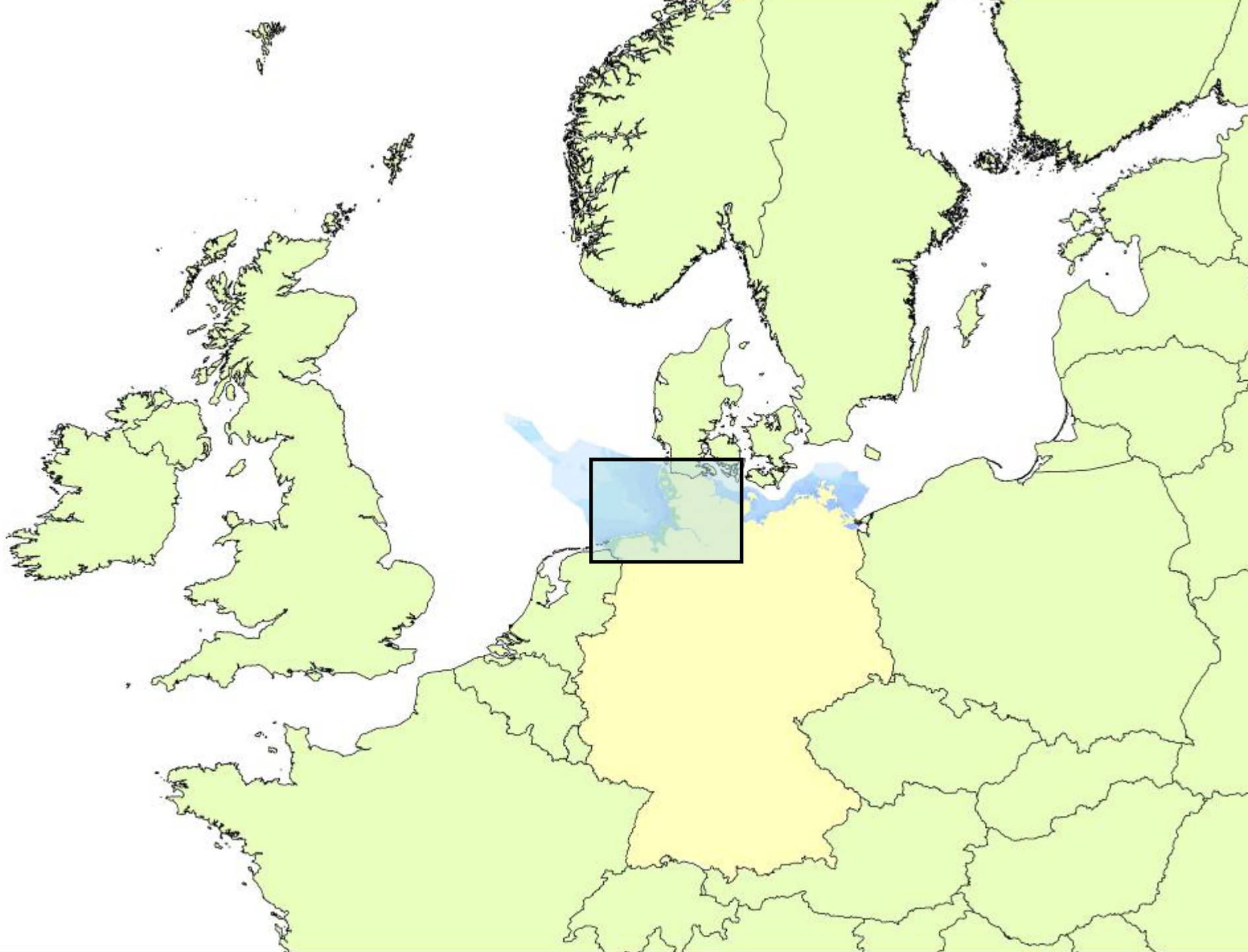
## Investigation of disposal process

- ADCP
- Nutrients/ Oxygen saturation/ CTD
- Modelling SPM (BAW: Federal Waterways Engineering and Research Institute)

## Investigations of the disposal site

- Multibeam soundings
- Sediment/ Fauna / Ecotox/ Contaminants in sediment and biota



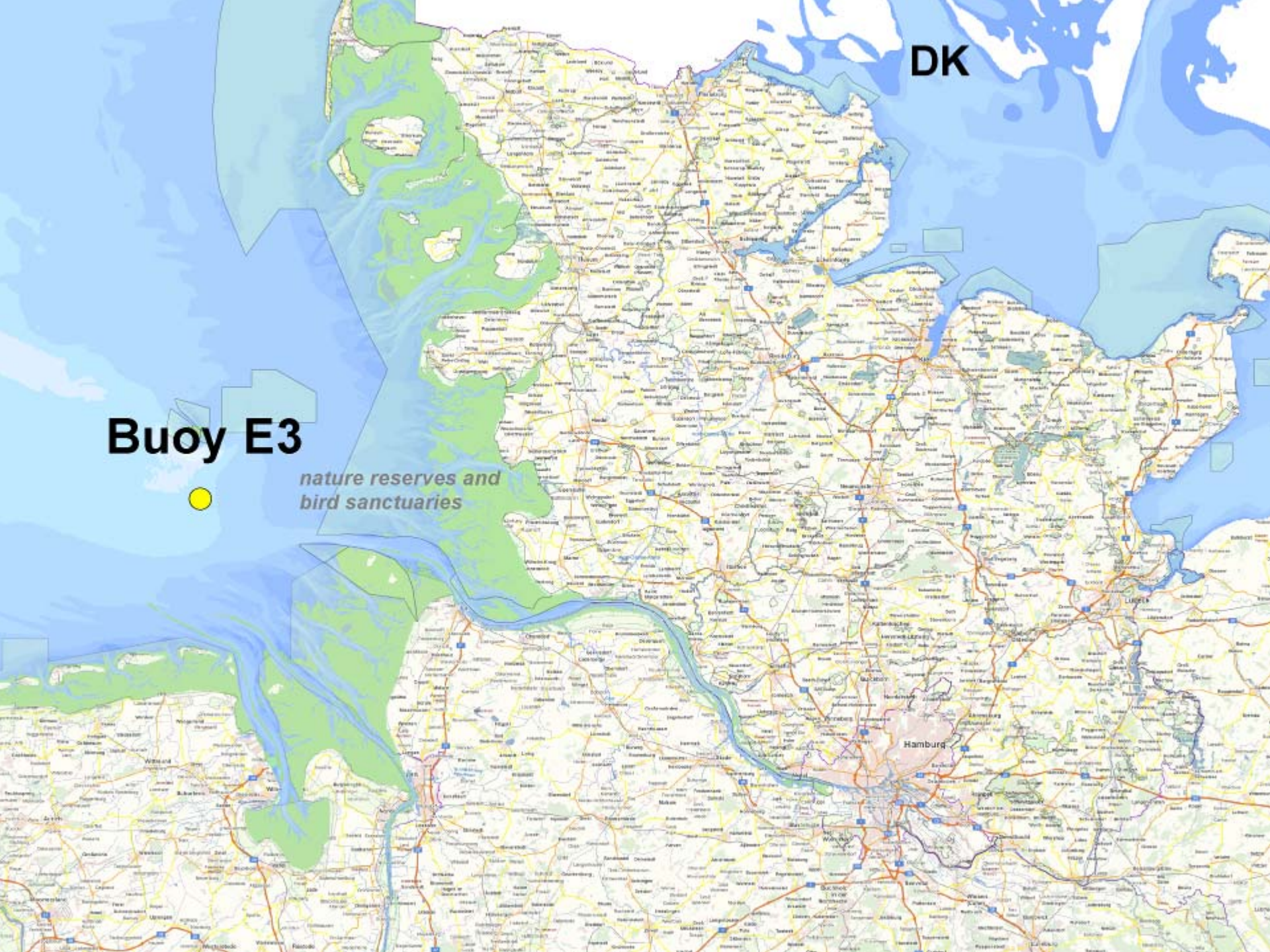


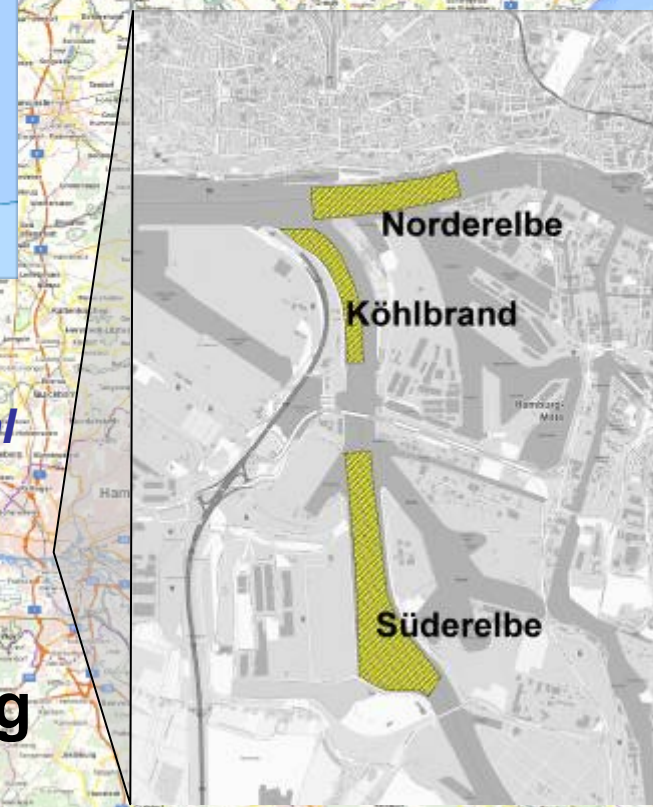
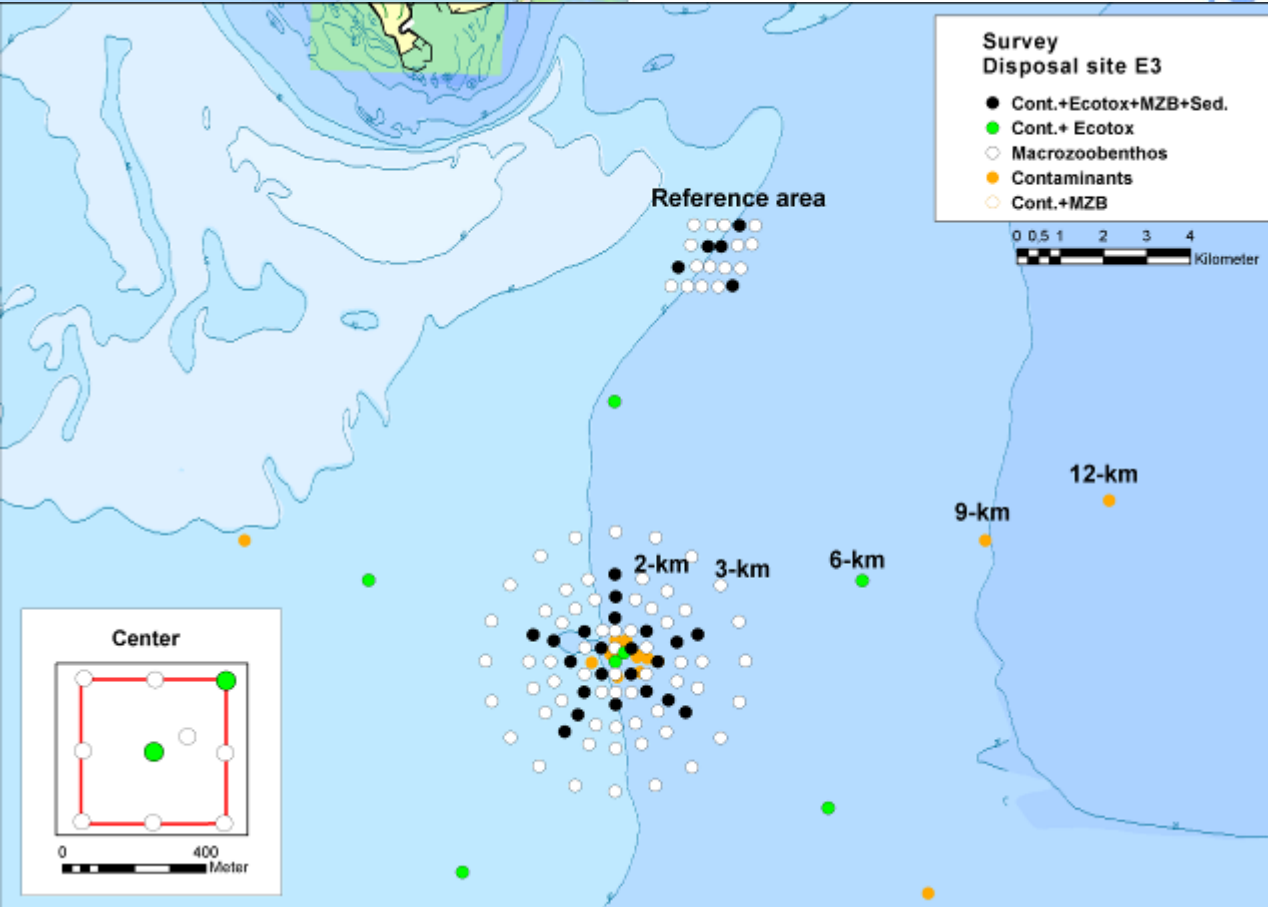
DK

**Buoy E3**



*nature reserves and  
bird sanctuaries*





Area	number of positions		
Centre	10	6-km	5
1-km	24	9-km	4
1,5-km	20	12-km	2
2-km	20	Ref area	20
3-km	20	Sum	125



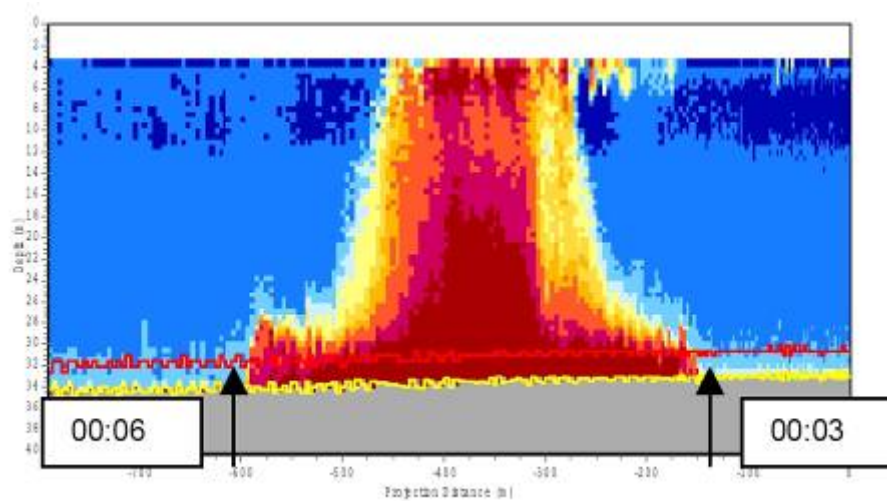
**Port of  
Hamburg**



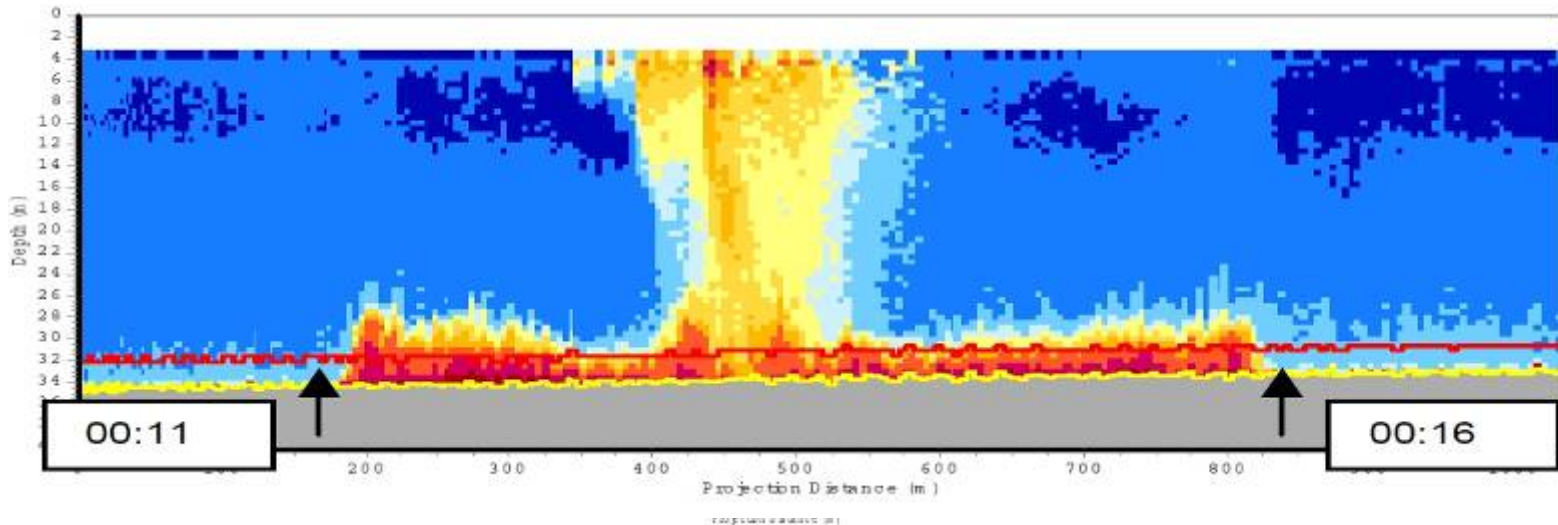


# Disposal of sediments

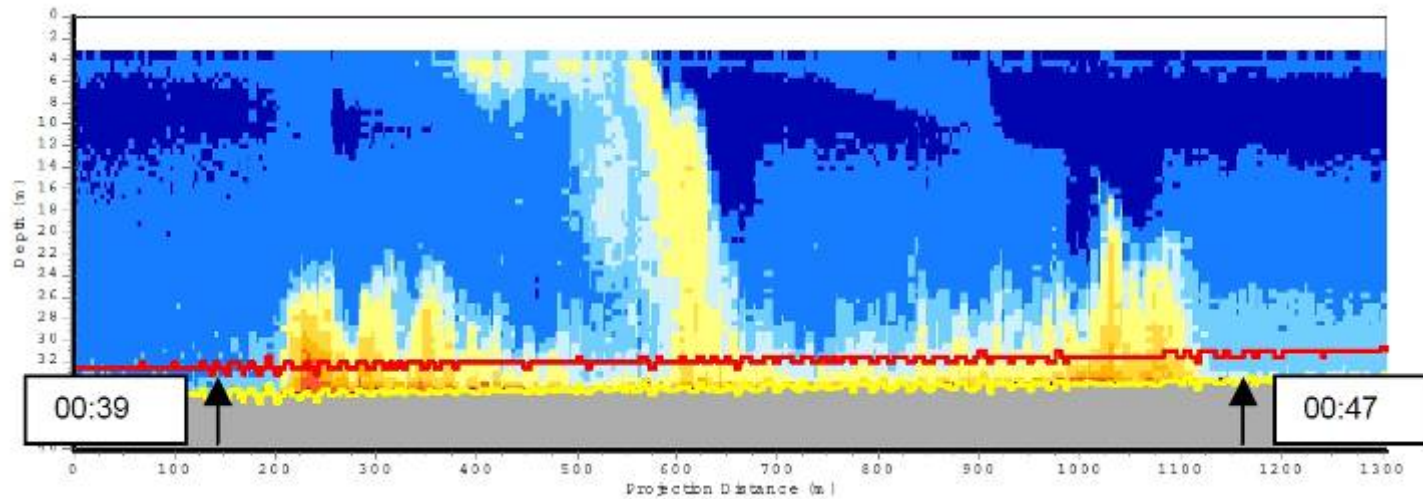
## -ADCP investigations-



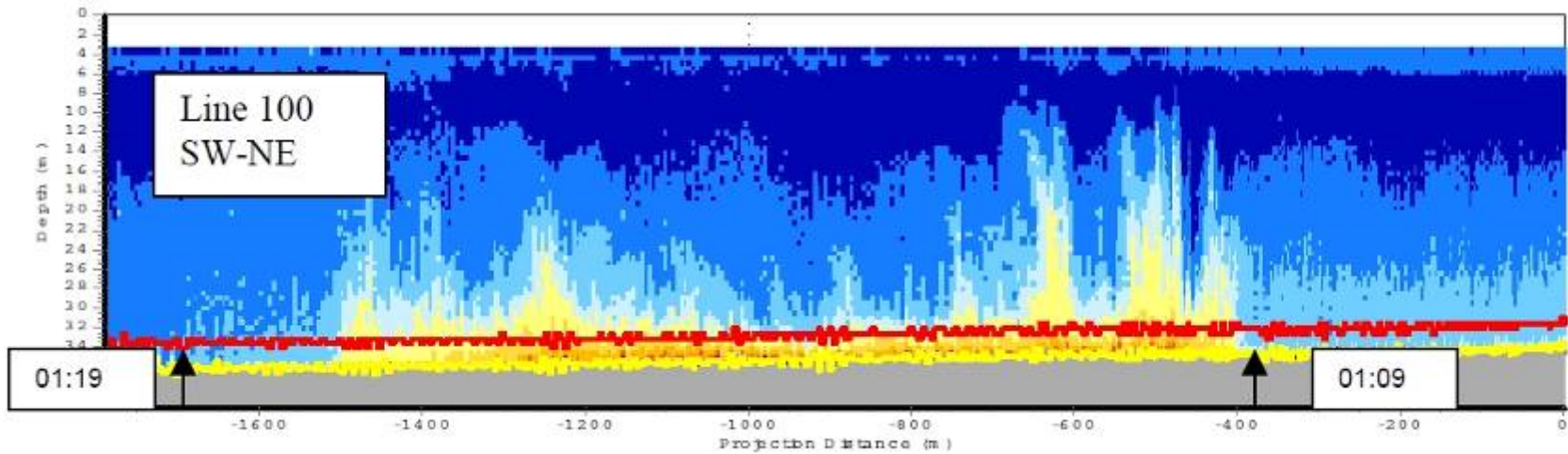
## -ADCP investigations-

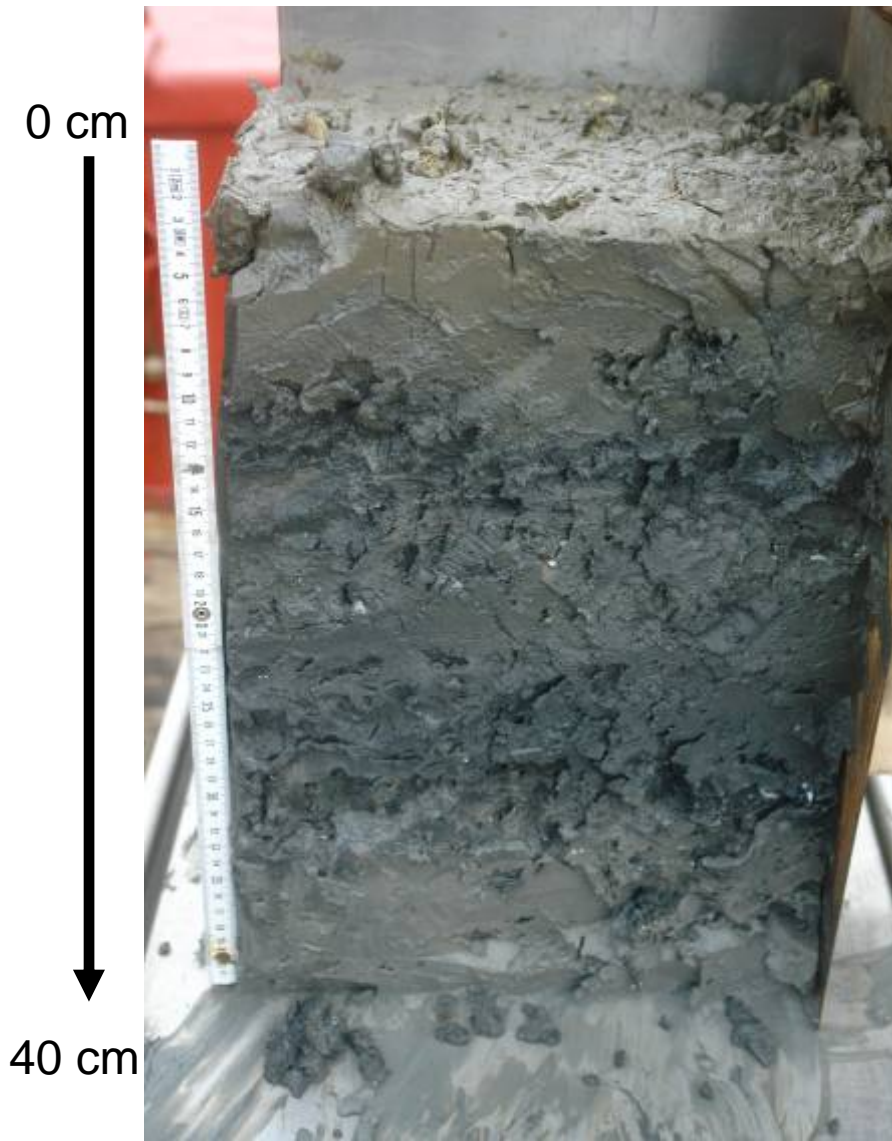


## -ADCP investigations-



## -ADCP investigations-





**Segregated, sandy  
sediment**

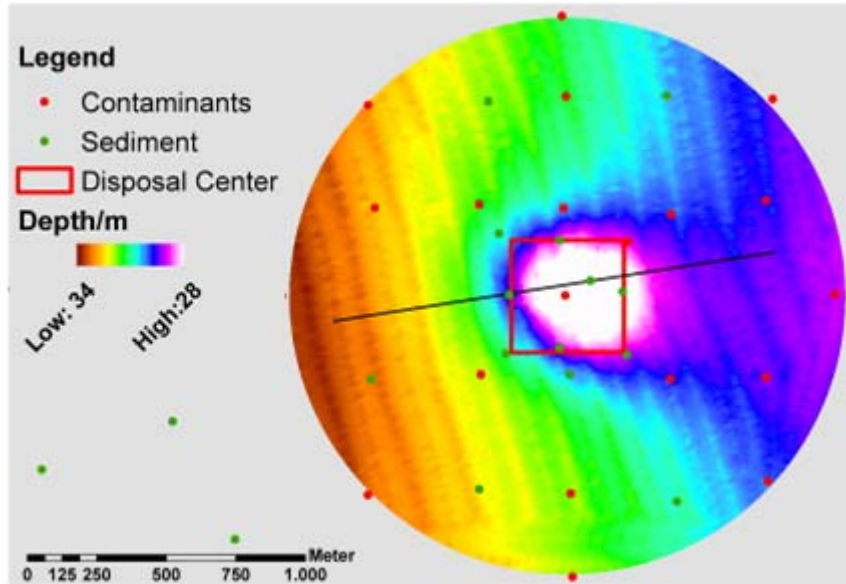
**Fresh  
North Sea Sediment**

**Consolidated  
North Sea Sediment**

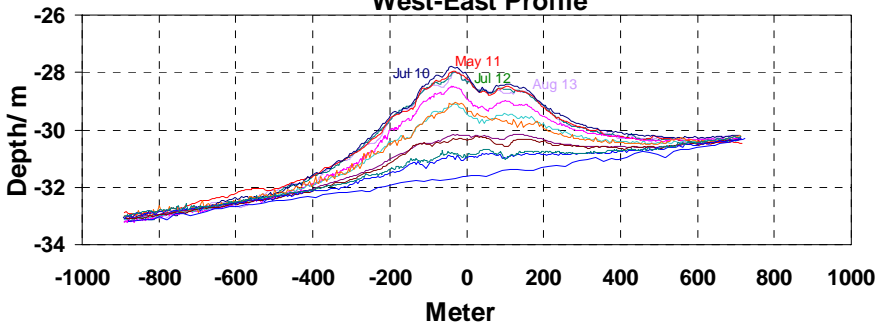


## Influence of disposal

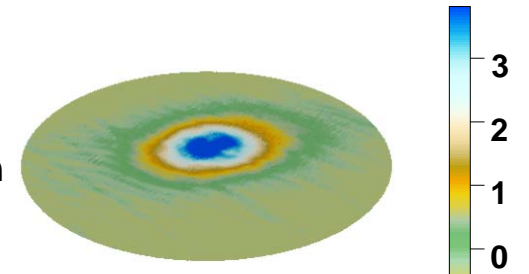
### Disposal site



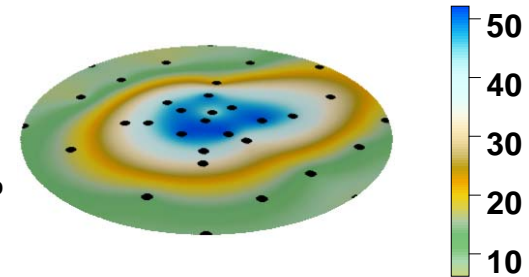
### West-East Profile



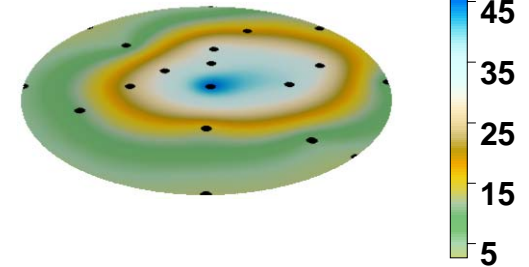
**Sediment Accumulation meter**



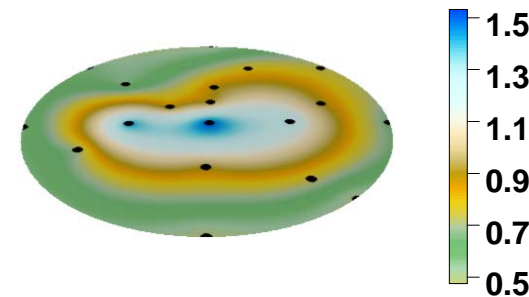
**Grain size 100-200  $\mu\text{m}$  %**



**TBT <2mm  $\mu\text{g}/\text{kg dw}$**



**Cd <20 $\mu\text{m}$   $\text{mg}/\text{kg dw}$**

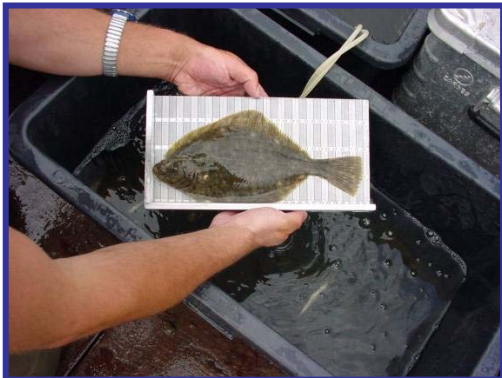




***Abra alba***  
**white furrow shell**



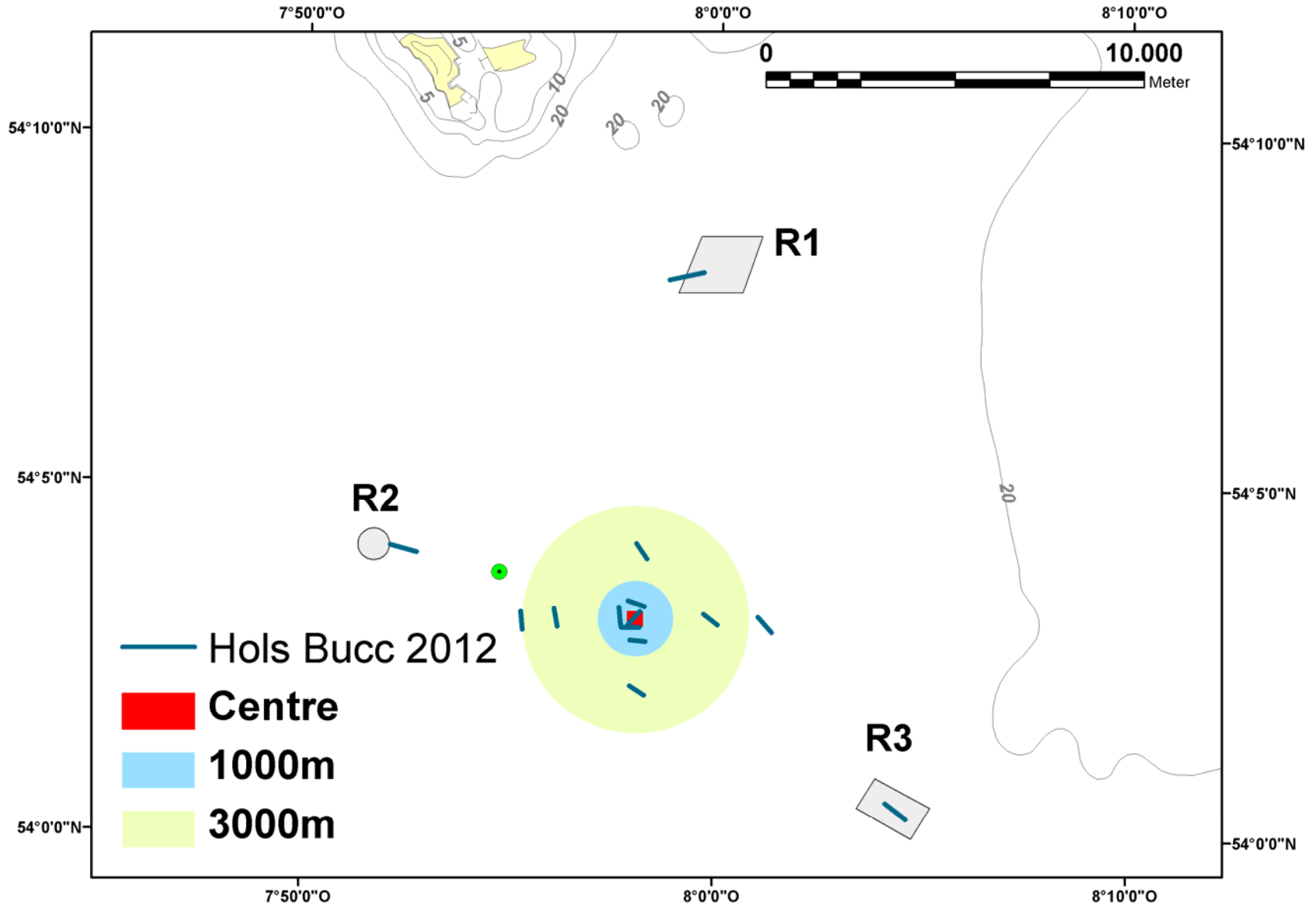
***Buccinum undatum***  
**common whelk**



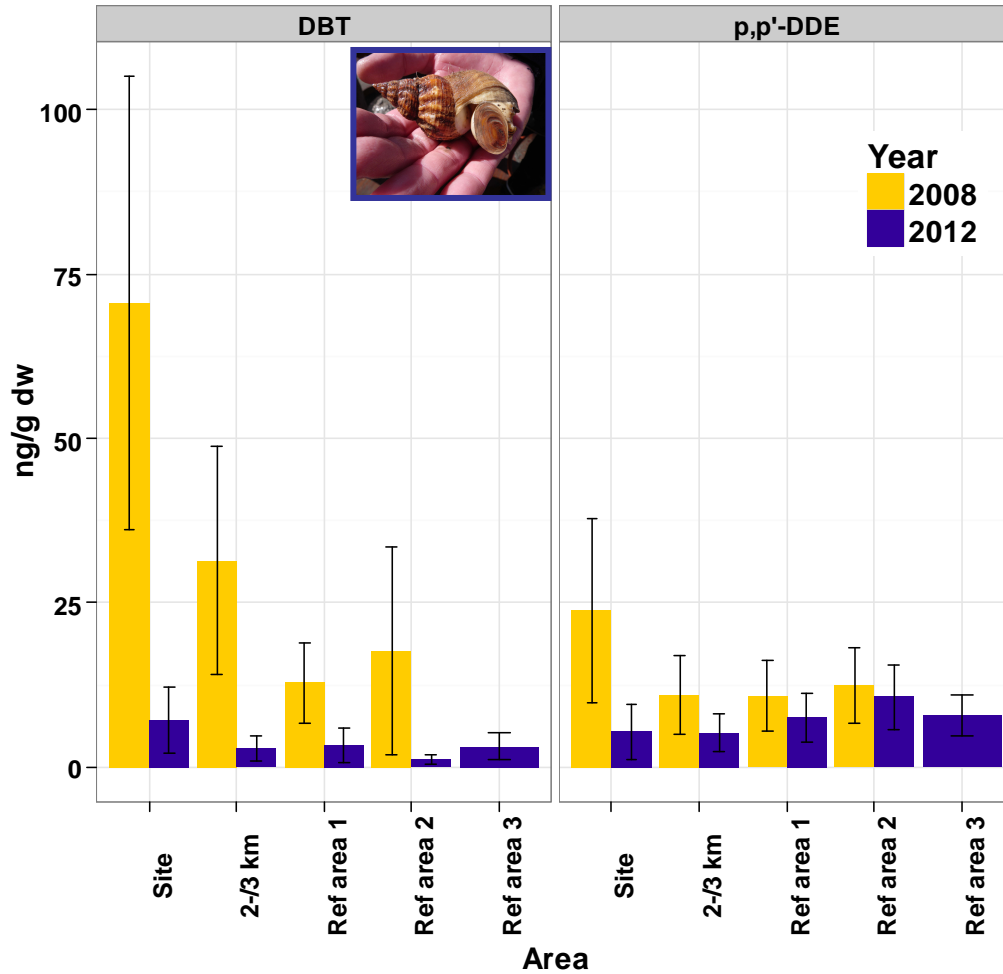
***Limanda limanda***  
**common dab**





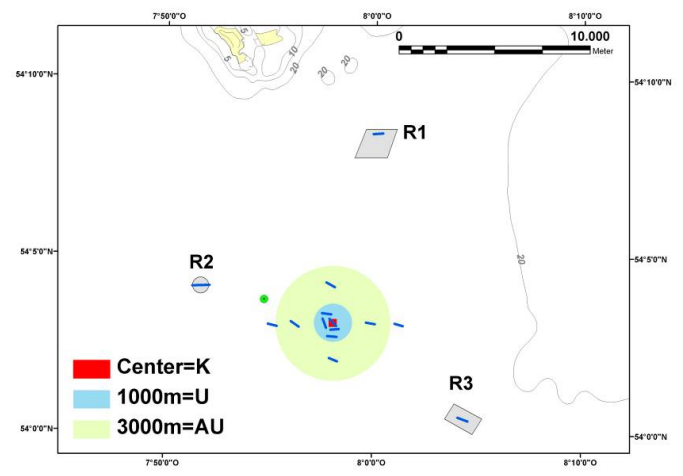


## Common whelk



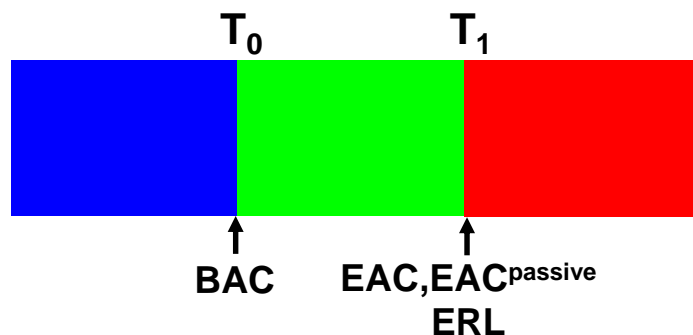
**Increased accumulation in tissue of common whelk**  
DBT , p,p'-DDE  
(and MBT,p,p'-DDD)

**No increased accumulation in tissues of white furrow shell, common dab (liver and muscle)**

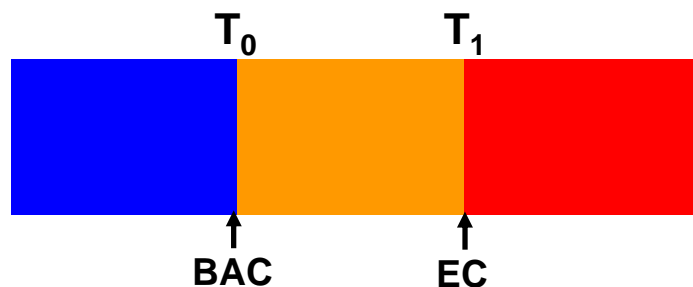


## Sediment/ Biota

Proposed transition points for PAHs and CBs in sediment and biota and metals in sediment



Proposed transition points for metals in biota



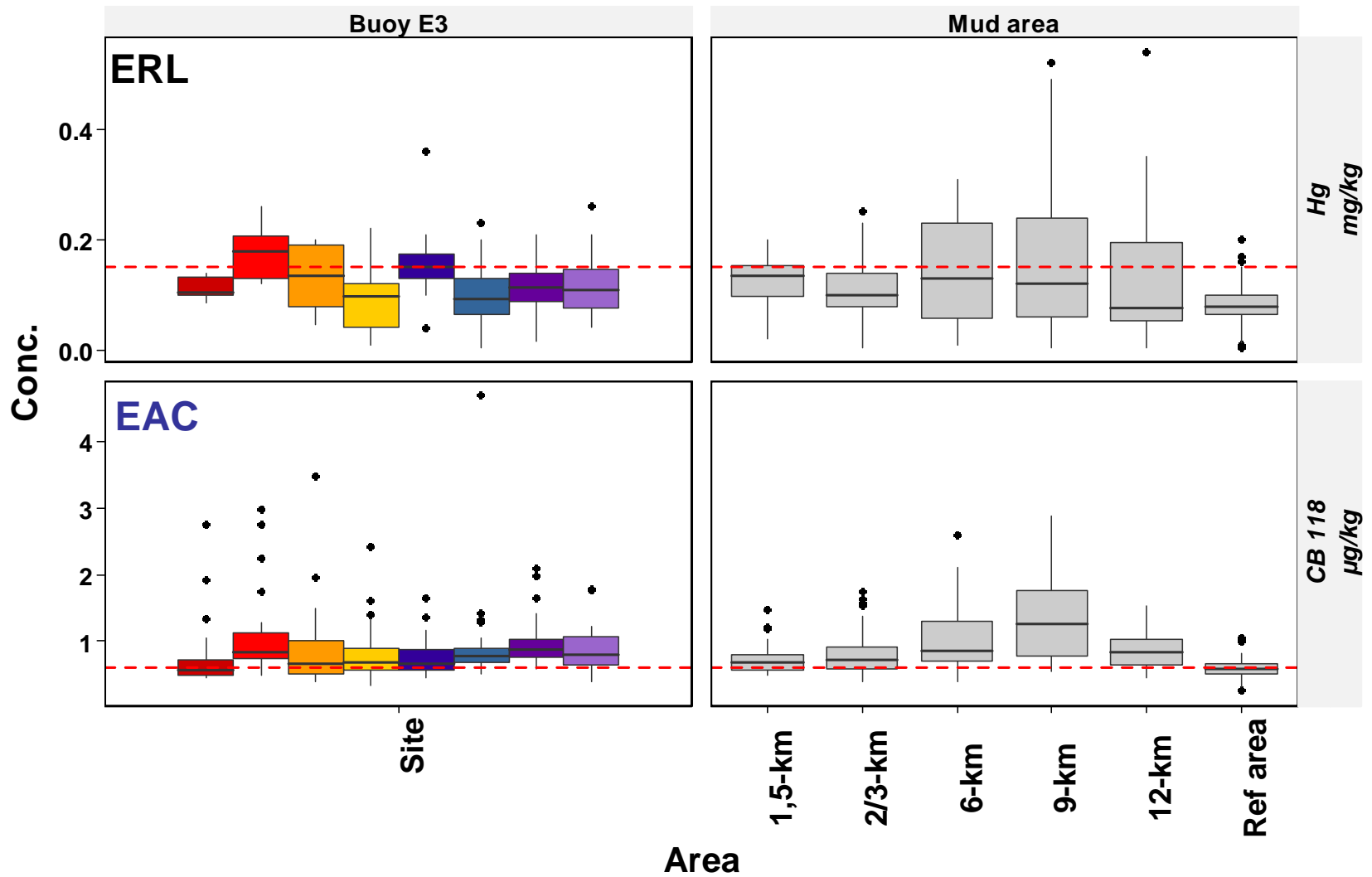
Recommended transition points

Standardisation	Transition Point	Sediment <2mm	Biota
PAH 2,5% TOC/ EAC	T1	ERL	EAC
CB 2,5% TOC/ EAC	T1	EAC	EAC <sup>passive</sup>
Metal 1% TOC/ EAC	T1	ERL	EC

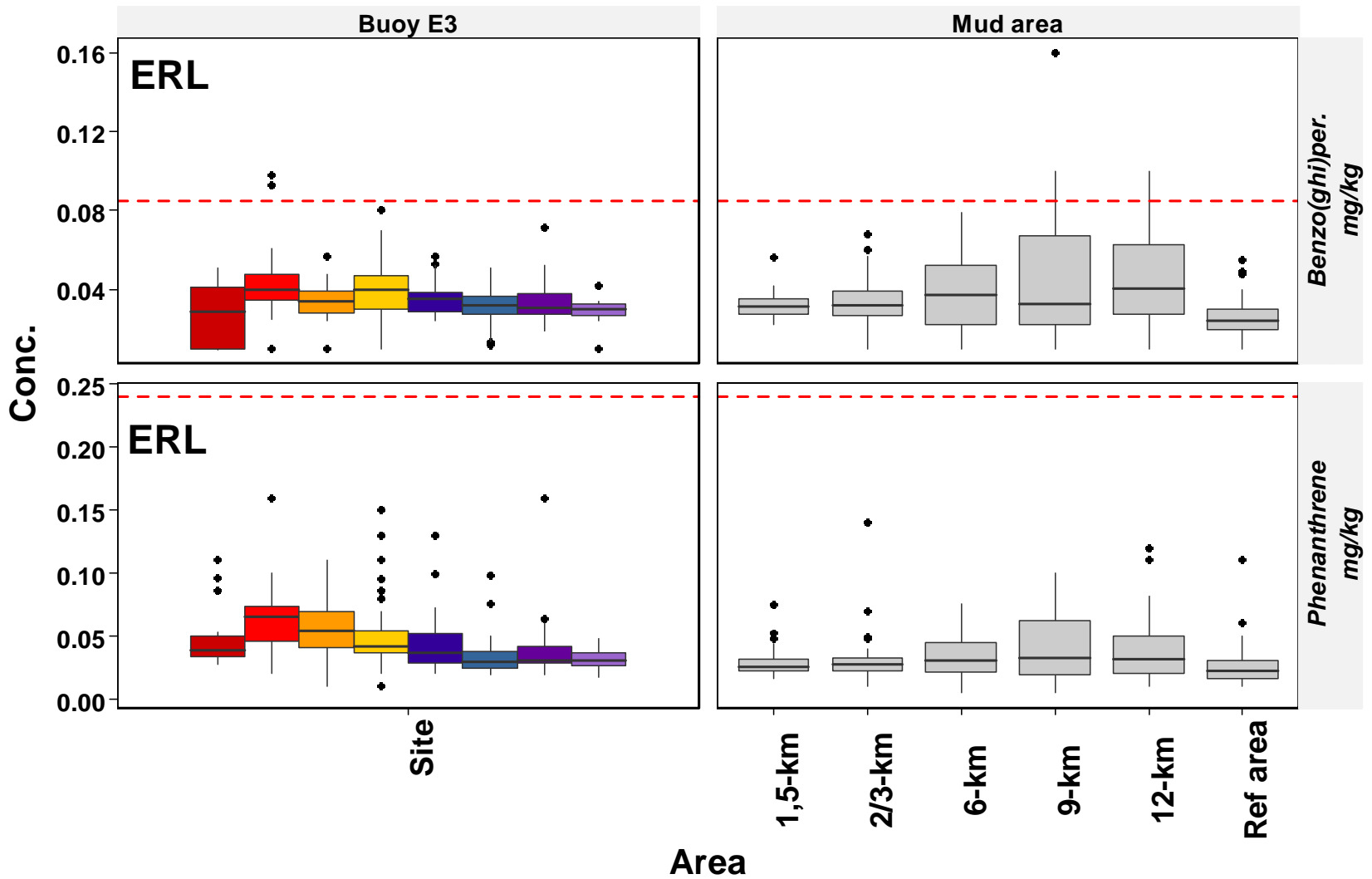
Environmental Assessment Criteria (**EACs**)  
Background Assessment Concentrations (**BACs**)  
Effects Range-Low (**ERL**) value

**EAC<sup>passive</sup>** (BSAF, dry and lipid weight normalized)  
**EC** maximum acceptable dietary levels  
**EQS** Environmental quality standard (WFD)

## Trace metals, CBs, PAHs in sediment



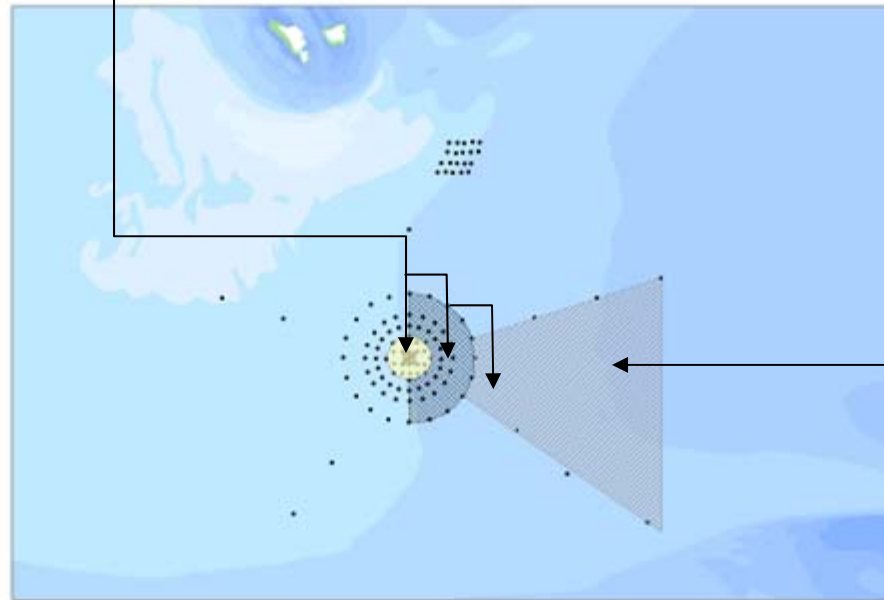
## Trace metals, CBs, PAHs in sediment



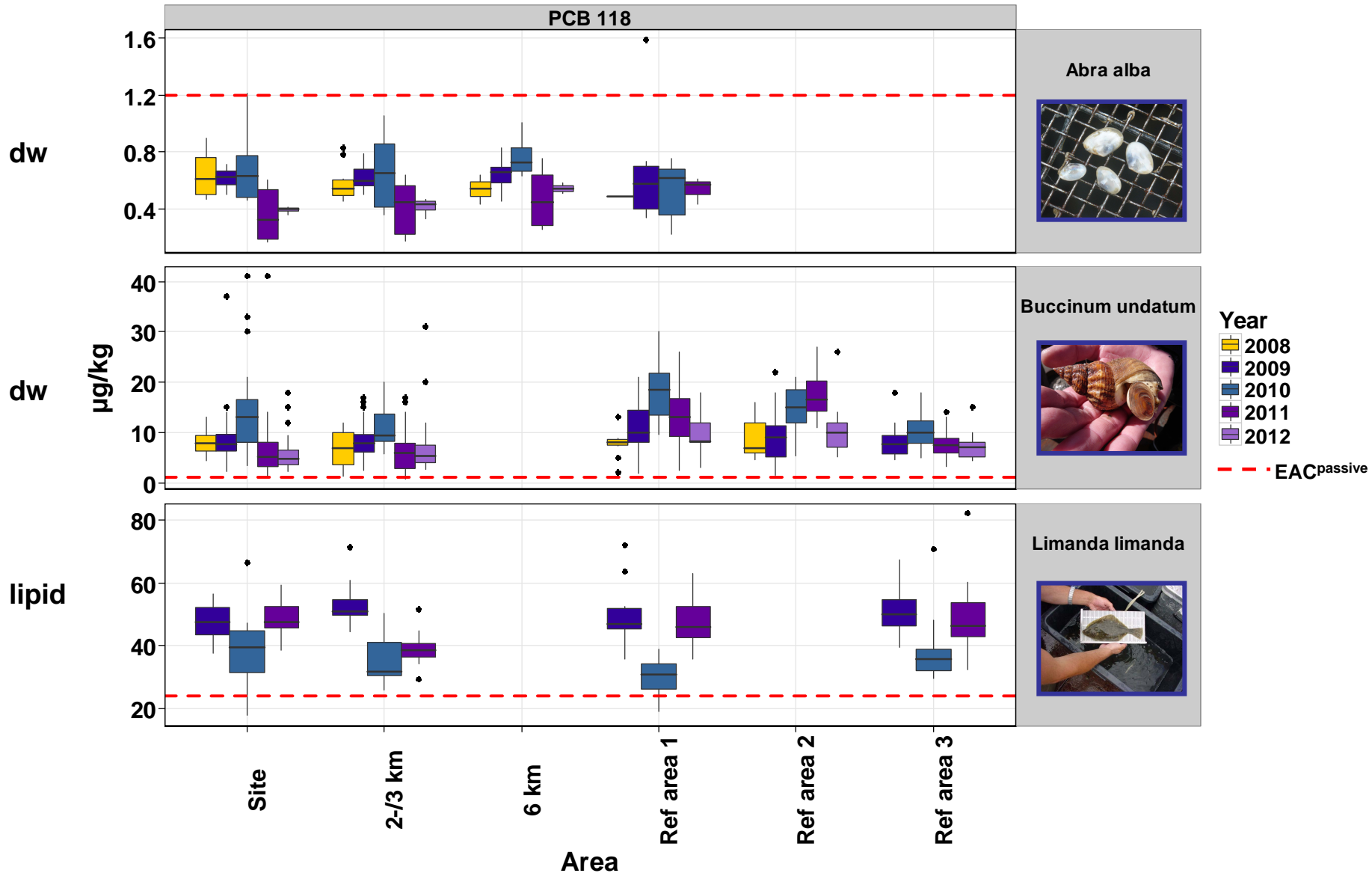
## Trace metals, CBs, PAHs in sediment

Arithmetic mean: Oct 2005-Aug 2012

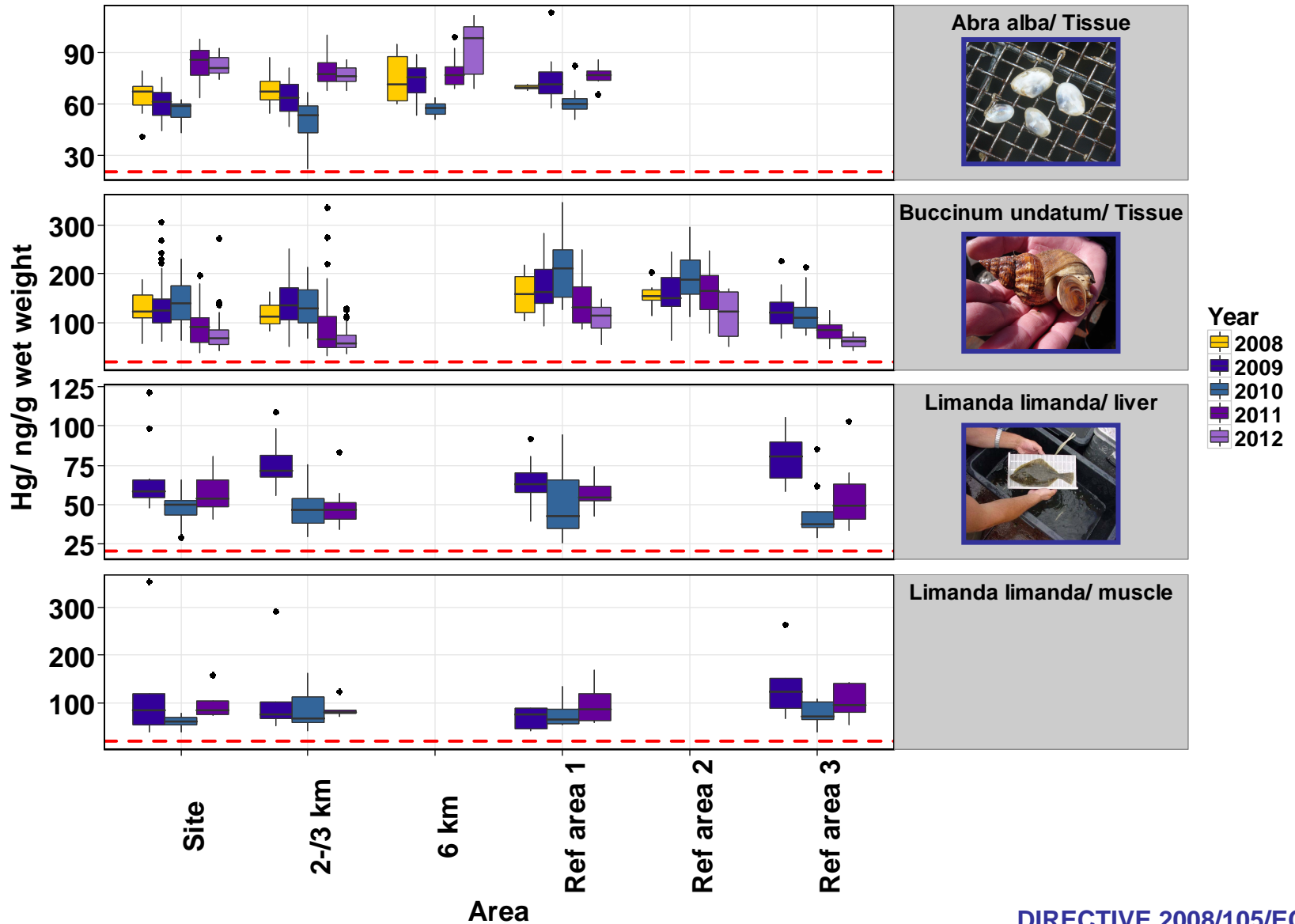
Parameter	Criteria	Exceedance	Range	Area
<b>trace metals</b>	ERL			
Hg	0,15	yes	0,153	farfield
Pb/Cd		no		
<b>PAH (9)</b>	ERL	no		
<b>PCB (7)</b>	EAC			
CB 118	0,6	yes	0,74-1,18	site, near- and farfield



*EAC*<sup>passive</sup>



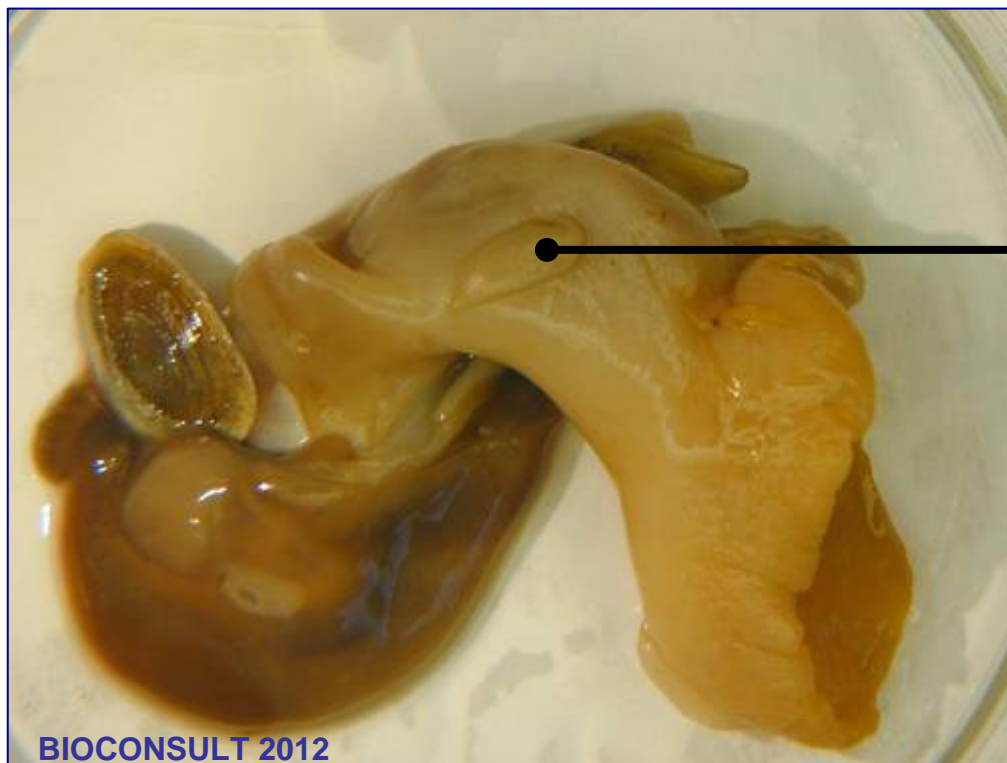
## EQS (EC)





# Imposex effect on biota










## Penis classification index (PCI)



BIOCONSULT 2012

**Common whelk**

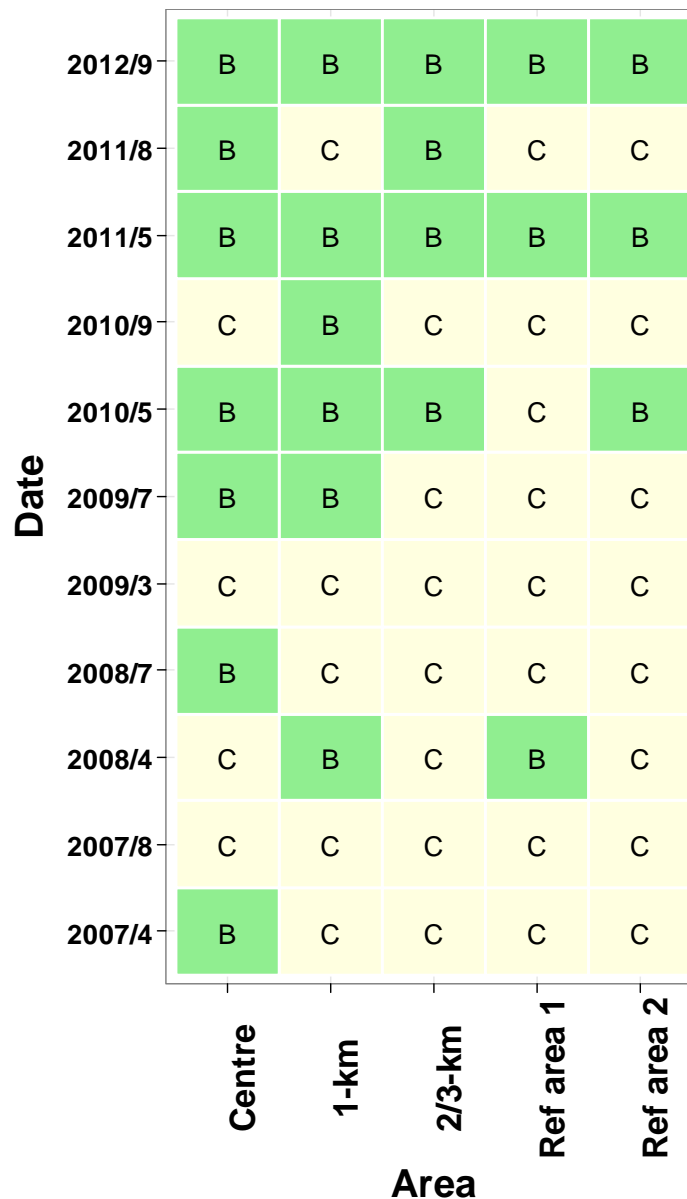
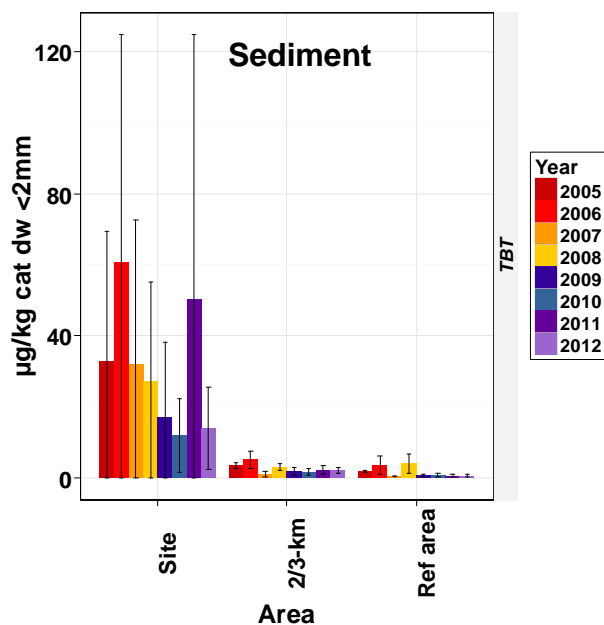
### Female: Imposex-stadium with Penis formation

Imposex stage	seen from above	seen from the side
0		
	No development of penis. Smooth epithelium at the site, where males have their penis.	
1		 or 
	Small knob at penis site indicating the development of a penis.	
2		
	Small structure penis, which can wobble and be lifted up from the epithelium of the foot.	
3		
	Penis is bent and with a shape which tends to look like a normal male penis.	

## *Buccinum undatum*

Assessment Class	PCI	Interpretation
<b>A</b>	<0,3	exposure to TBT concentrations close to zero
<b>B</b>		adverse effects are predicted unlikely to occur
<b>C</b>	0,3 - 2,0	risk of adverse effects
<b>D</b>	2,0 - 3,5	evidence of adverse effects associated with the exposure to TBT
<b>E</b>		no reproduction
<b>F</b>	> 3,5	population of sensitive gastropods is absent/expired

Provisional JAMP Assessment Criteria for TBT, 2004-15



## *Impact on marine environment*

### Sediment

- Stable accumulation of **sediment body**
- EAC-exceedance of some contaminants in **sediments** (PAHs and CBs) **at the centre of the disposal site**
- **Decreasing** contaminant concentrations
- EAC-exceedance of CB118 **in whole area**



### Biota

- Accumulation of contaminants in **common whelk** tissues restricted to the centre of the disposal site (MBT, DBT, p,p'-DDD, p,p'-DDE)
- **Decreasing** contaminant concentrations
- No increasing imposex effect on **common whelk** by disposal
- EAC-exceedance of some contaminants (Pb, Hg, CB118, 138) **in whole area**

### Criteria

- EAC not finalized
- Exceedance reflects general pressure exerted by human activity on coastal areas



