



# ***Water quality improvement by mussel cultivation – Case study Szczecin Lagoon, Baltic Sea***

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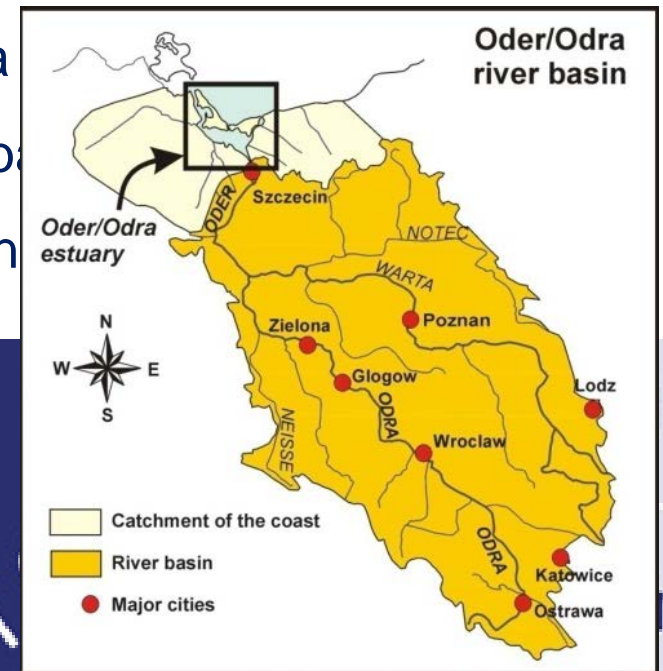
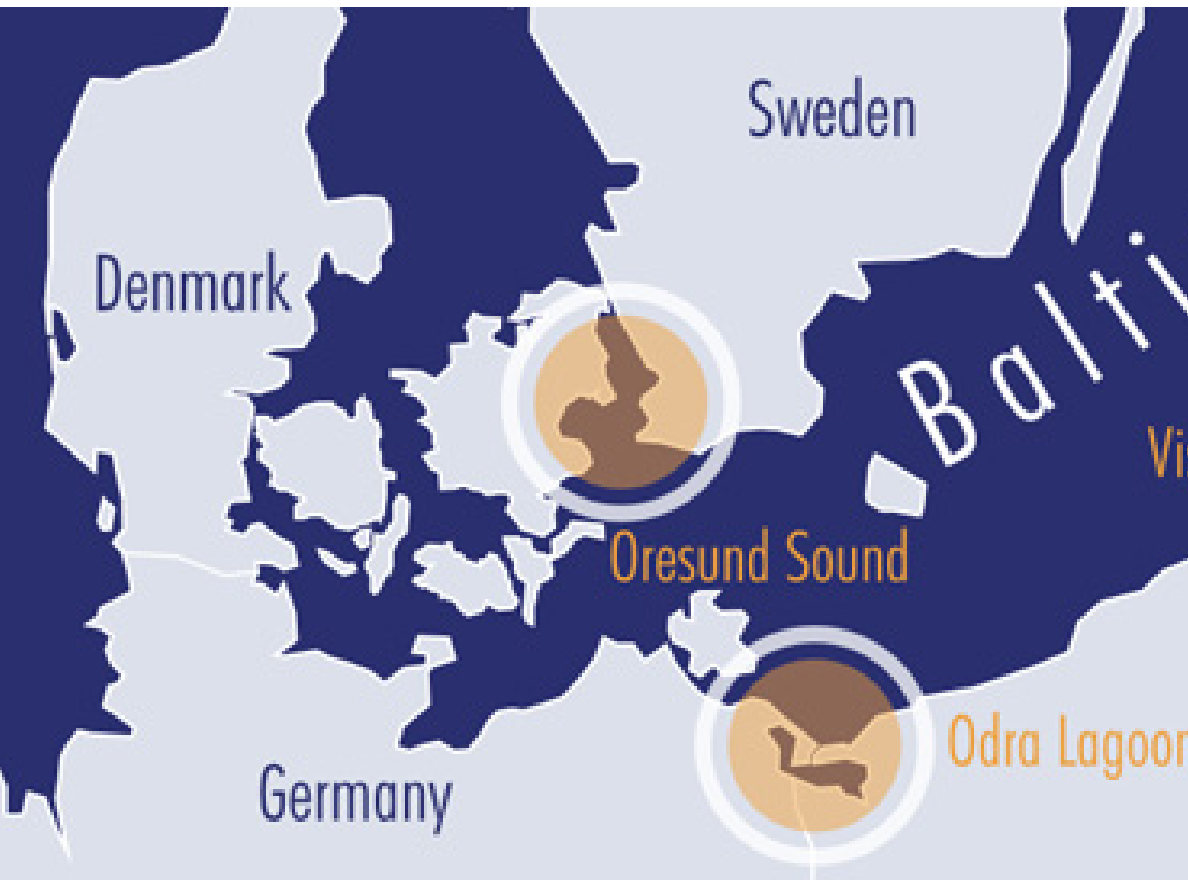
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Oostende, 28.11.2012

# Transitional waters of the South Baltic Sea region

- Buffering function for protecting the Baltic sea
- Influenced by high nutrient loads in the river basin
- WFD demands good ecological status, currently





# Eutrophication



Chl a  
Good status:  $<12,7 \mu\text{g/l}$   
status 2007:  $68,6 \mu\text{g/l}$



Algae blooms of *Anabaena* spec. (2008)  
and *Microcystis* spec. (2010)

# Methods of restoration / Eutrophication abatement

## Biological:

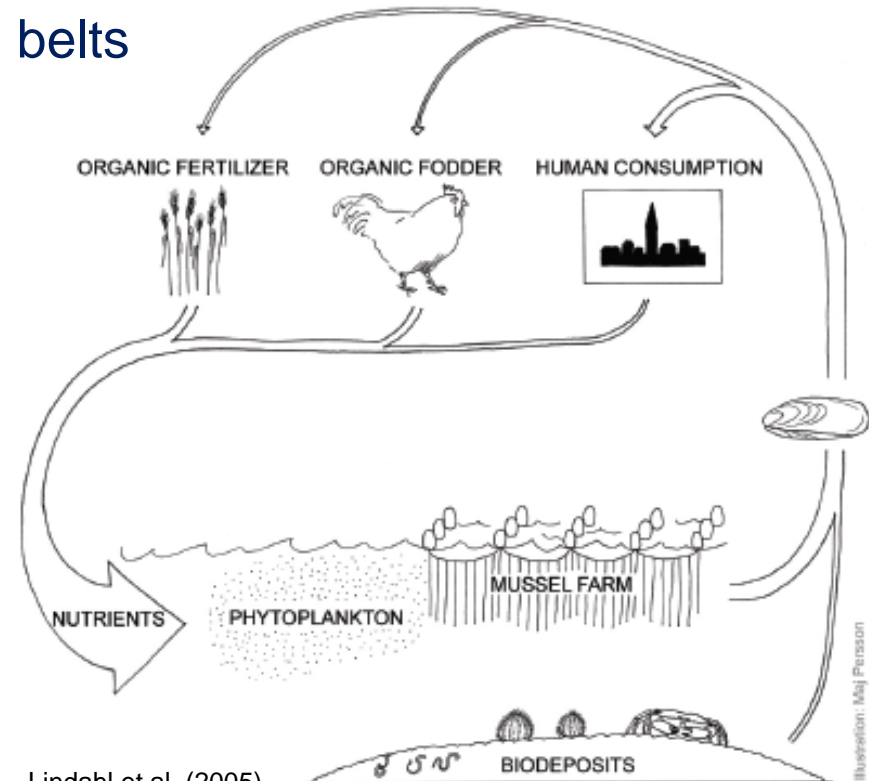
- Mussel cultivation and enlargement of natural mussel beds
- Cultivation of macro algae
- Enlargement and management of reed belts

## Mechanical:

- Dredging of sediment and dumping on land
- Sediment capping

## Chemical:

- Precipitation of nutrients





# Mussel farming trials in the Baltic Sea



**X** = ongoing or completed small scale trials

**★** = ongoing or completed large scale trials

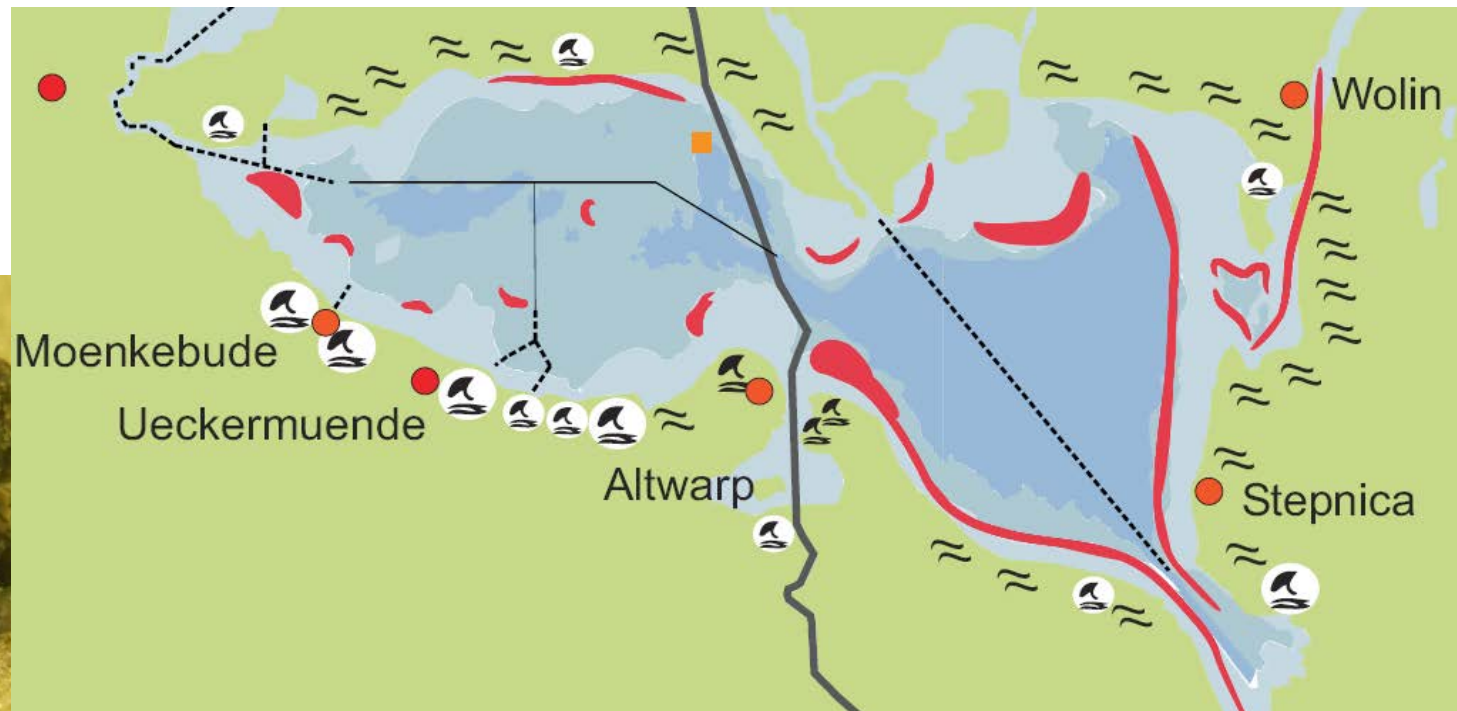
**Z** = zebra mussel trials

**≡** = seafood mussel production



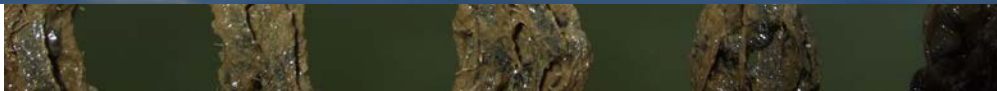
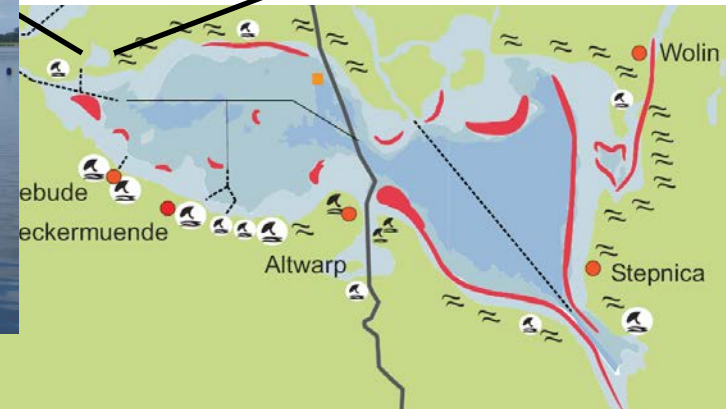
# Zebra mussel beds in the Szczecin Lagoon

- Biomass: ca. 68.000 t, thereof 8.000 t in the German part (Radziejewska et al. (2009))
- Coverage in the German part: 6,56 km<sup>2</sup> or 2,4 %
- Main problems for natural settlement: missing hard substrate and risk of anoxia



# Zebra mussel cultivation in the Szczecin Lagoon

- Pilot station of University of Greifswald in Usedomer See since May 2012
  - space of 100 m x 100 m with 6 net collectors of 240 m<sup>2</sup>
  - settlement by regular spat fall



# SWOT-Analysis of zebra mussel cultivation

Strenghts	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Environmentally friendly</b>, „native“ species</li> <li>• <b>Removal of nutrients</b> by periodic harvest</li> <li>• <b>Improvement of ecosystem quality</b> by increased biodiversity</li> <li>• <b>Low limitation by spatfall</b> in comparison with bottom cultures</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Uncertain commercial use</b> because of slow growth and small harvest size</li> <li>• <b>Increased concentration of heavy metals</b> affects mussel use for animal husbandry</li> <li>• <b>Reduction of mussel biomass</b> by predators (fish, waterfowl) or lack of food</li> <li>• <b>No tradition and experiences</b> in mussel cultivation</li> <li>• <b>Uncertain legal and planning situation</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Resettlement of macrophytes</b> by improved water transparency</li> <li>• <b>Altered food web interactions</b>, more benthic feeding fish and expanded fishery</li> <li>• <b>New regional jobs</b> in harvesting and processing of mussels</li> <li>• <b>Higher number of tourists and overnight stays in summer season</b> by improved water transparency</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Local anoxic surface sediment</b> by deposited organic material</li> <li>• <b>Bothered tourists</b> by mussel shells washed ashore</li> <li>• <b>Material damage</b> by fouling of boats, gillnets etc.</li> <li>• <b>Damage of net structures</b> by ice cover in winter</li> </ul>





# Legal aspects

## Legislation on different levels

1. International Law
2. European Union Law
3. National Law: German Law; federal system: Bund / Länder  
Polish Law

No aquaculture law!

## Lack of appropriate legislation

Germany: Little experiences with mussel aquaculture

Szczecin Lagoon:

- Mussel cultivation = fisheries?
- Definition as fishery method or method for water protection?

->fishery method would be easier to implement



## Legal aspects

### Relevant laws:

- Law of Fisheries incl. the Right of fishing
- Building Law
- Water Law
- Shipping Law
- Environmental Impact Assessment required

### Permission depends on:

- structure, size and place of construction
- method of cultivation (e.g. nutrient input, risk of anoxia)

Environmental Law: lagoon is part of NATURA 2000 network -  
permission under environmental law possible?



# Legal aspects

## Critical reflection of German Federal Environmental Agency (UBA)

Mussel farming can lead to impacts on benthic fauna and in case of hazardous substances stored in the sediments these can be released under anoxia

1. Too much threats! – Too little long-term experiences
2. Nutrient inputs must be remediated at source / as close to the source as possible

-> Agency is against using large-scale mussel farming !



# Acceptance of fishermen

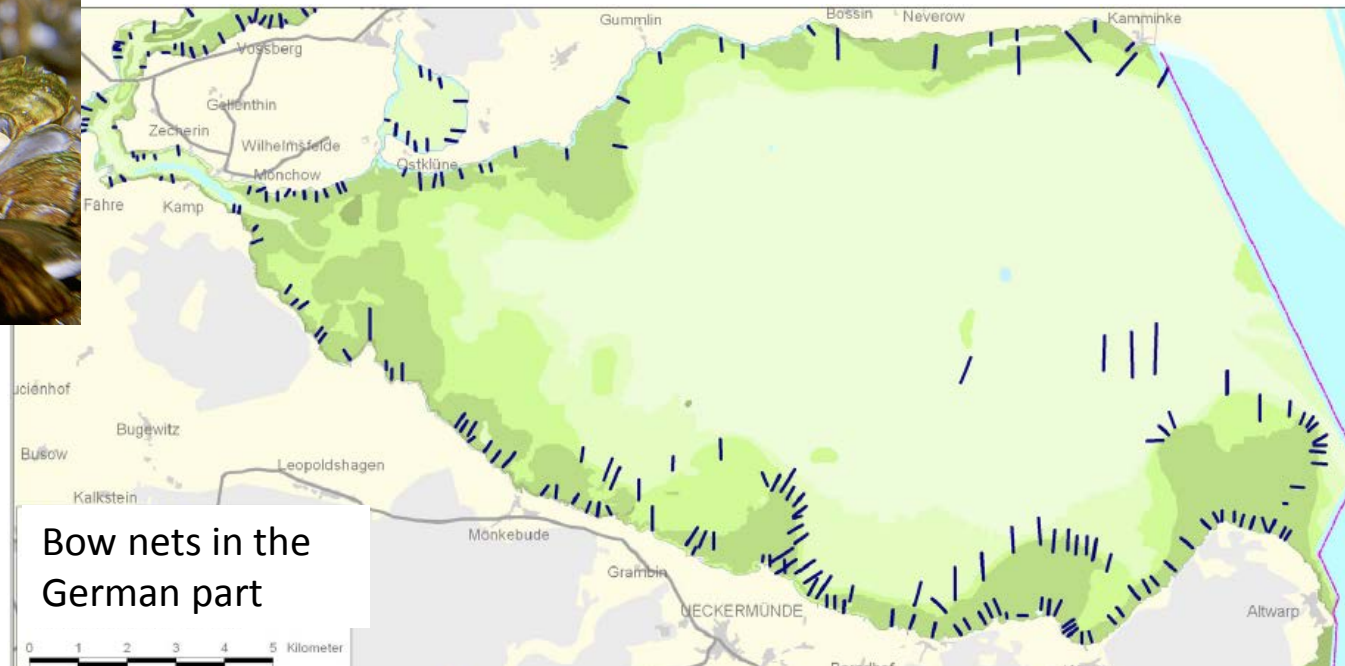
## Interview results

See problems in:

- competition with traditional fishery
- spatial use conflicts
- provision of invasive species (round goby) by cultivated food



Wikipedia



Bow nets in the  
German part

# Problems of implementation

- Fishermen / potential farmers tend to have a narrow short-term view
- stakeholders do not recognise ecological and economic value of bioremediation
- lack of tools, incentives and help of authorities to support bivalve farming for bioremediation



# Interview campaigns to analyse value of water quality

2008:  
450 around lagoon,  
mainly Germany

2012:  
410 in Szczecin, Poland

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Data: \_\_\_\_\_ Miejscowość: \_\_\_\_\_ Ankieter: \_\_\_\_\_ Godzina: \_\_\_\_\_

- Czy mieszka Pan/Pani w Szczecinie albo w jego przedmieściach?  
☐ tak ☐ nie (koniec ankiety)
- Jaki kod pocztowy ma Pana/Pani miejsce zamieszkania? PL-.....
- Dokąd pojedzie Pan/Pani w tym roku na urlop letni (lato: maj - wrzesień)?  
.....(miejscowość, kraj) ☐ nie planuję urlopu (dalej pytanie 6)
- Ile czasu spędzi Pan/Pani w wybranym miejscu? .....(dni)

5. Co oferuje dane miejsce?	tak	nie	nie wiem
Piaszczysta plaża	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dobry stan sanitarny wody w kąpielisku	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Przejrzysta woda w kąpielisku	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kawiarnie / restauracje	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marina / port	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sklepy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Możliwość wycieczek pieszych	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Natura / piękne krajobrazy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Jak często korzystał/a Pan/Pani w ciągu ostatniego lata z poniższych możliwości kąpieli w Szczecinie i okolicach (np. po pracy albo w weekend; nie podczas urlopu letniego)?

	...razy (maj – wrzesień)	ani razu	nie wiem
Kąpielisko miejskie / basen	.....	<input type="checkbox"/>	<input type="checkbox"/>
Okoliczne jeziora, rzeki (które?):	.....	<input type="checkbox"/>	<input type="checkbox"/>
1. ....	.....	<input type="checkbox"/>	<input type="checkbox"/>
2. ....	.....	<input type="checkbox"/>	<input type="checkbox"/>
Zalew Szczeciński (które miejscowości?):	.....	<input type="checkbox"/>	<input type="checkbox"/>
1. ....	.....	<input type="checkbox"/>	<input type="checkbox"/>
2. ....	.....	<input type="checkbox"/>	<input type="checkbox"/>
Wybrzeże zewnętrzne Wolina/Usedom i Morze Bałtyckie (miejscowości)	.....	<input type="checkbox"/>	<input type="checkbox"/>
1. ....	.....	<input type="checkbox"/>	<input type="checkbox"/>
2. ....	.....	<input type="checkbox"/>	<input type="checkbox"/>
Inne: .....	.....	<input type="checkbox"/>	<input type="checkbox"/>

old  
44940

Befrager:  
Sichttiefe (cm):

er:

**angung 2008**

ah)? .....

sondem in .....

ngen

Privatzimmer ☐ Campingplatz ☐ .....

ist? Insgesamt ....., davon Kinder: .....

gaben? → für die Übernachtung: ca. .... €,  
→ für sonstige Ausgaben: ca. .... €

sedoms ..... mal; am Stettiner **Haff** ..... mal

lich	.... mal pro Woche	nie
<input type="checkbox"/>	.....	<input type="checkbox"/>
<input type="checkbox"/>	.....	<input type="checkbox"/>
<input type="checkbox"/>	.....	<input type="checkbox"/>
<input type="checkbox"/>	.....	<input type="checkbox"/>

ar wichtig	...urwichtig	k. A.
1.....2.....3.....4.....5		<input type="checkbox"/>
1.....2.....3.....4.....5		<input type="checkbox"/>
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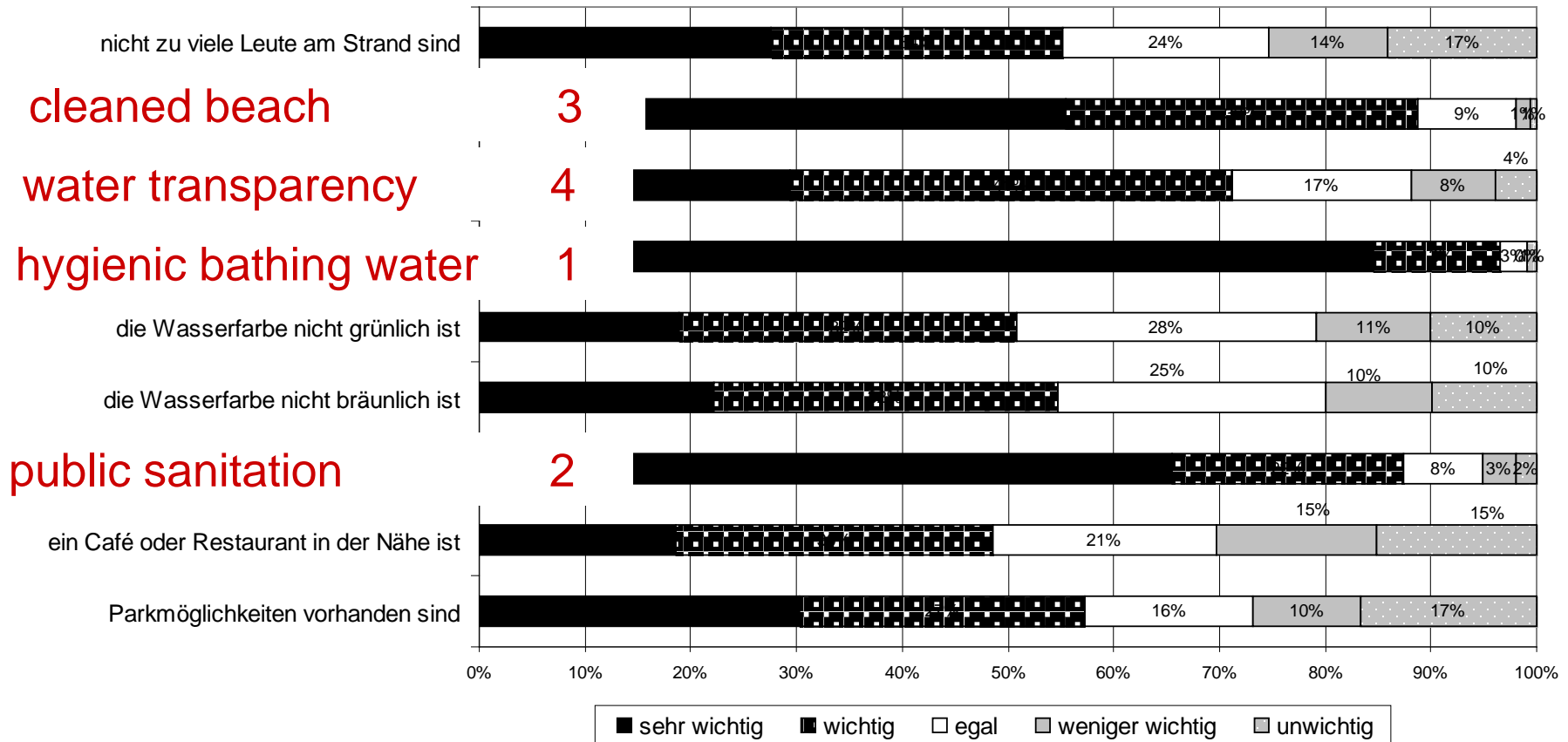
Ihren am **liebsten**?  
r bis auf den Grund sehen können (>2 m)  
te ich mind. meine Füße sehen können (>1m)  
och sehen können (60 – 100 cm)  
80 cm)  
en kam.



# Results of interview campaigns

Survey results in 2008 (12 beaches, 450 interviews): Water transparency plays an important role for tourists.

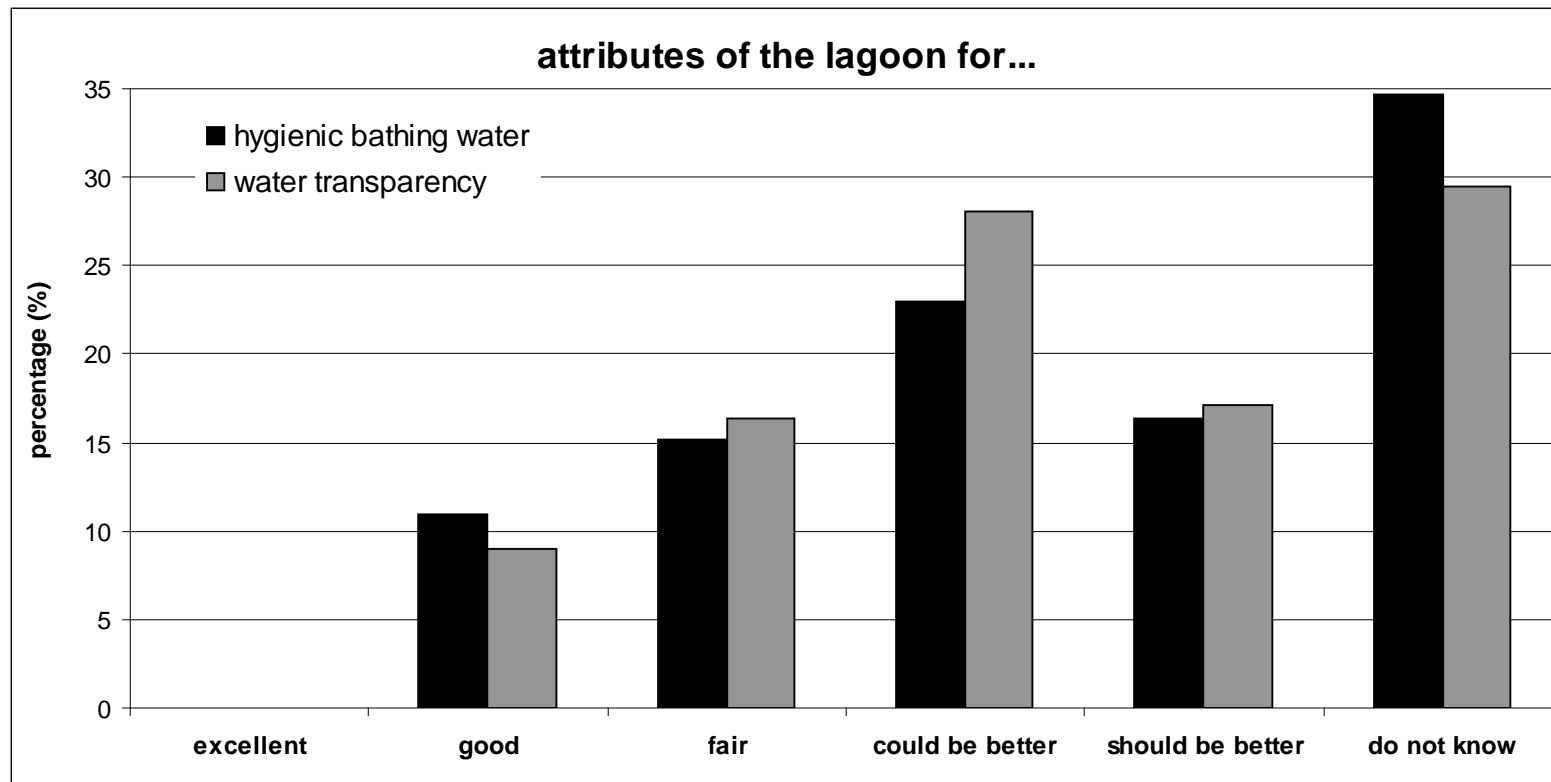
## How important is it to find following characteristics at the lagoon?



# Results of interview campaigns

Survey results in 2012:

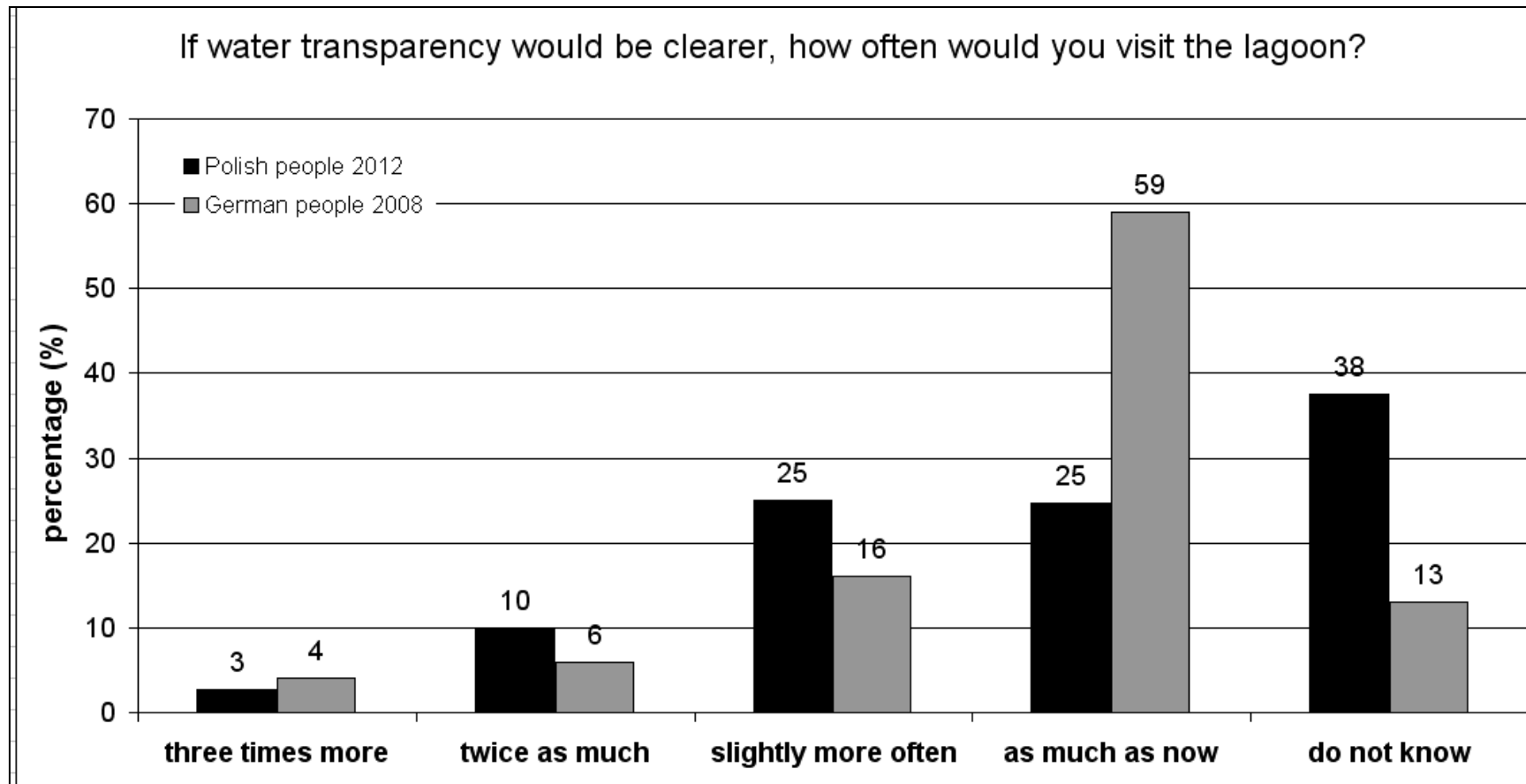
- 40% go regularly to the lagoon, mostly in summer
- Most of them come to the lagoon for a private day trip
- Just 13% use the lagoon for bathing
- 45% feel water transparency could/should be improved; 26% are satisfied



# Results of interview campaigns

Tourism potential, surveys 2008 and 2012:

Improvement of water transparency implies an increase of tourist arrivals. Ca. 30% of respondents will come more often.







## Summary

- Water transparency can play an important role in future development
- Improvement of water transparency would increase tourist arrivals by 30%
- Mussel cultivation as bioremediation measure is not widely accepted
  - No experiences and little knowledge in authorities
  - Fishermen need incentives to accept and test
- Pilot measures will help to generate results
- Projects as ARTWEI help to discuss bioremediation tools with authorities and enhance acceptance on both sides of the lagoon

# Thank you for your attention !



[www.balticlagoons.net/artwei/](http://www.balticlagoons.net/artwei/)

[www.aquafima.eu](http://www.aquafima.eu)



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