

Mussel farming in Baltic coastal waters Application of a System Approach Framework

Part 1

Greifswalder Bodden (bay)

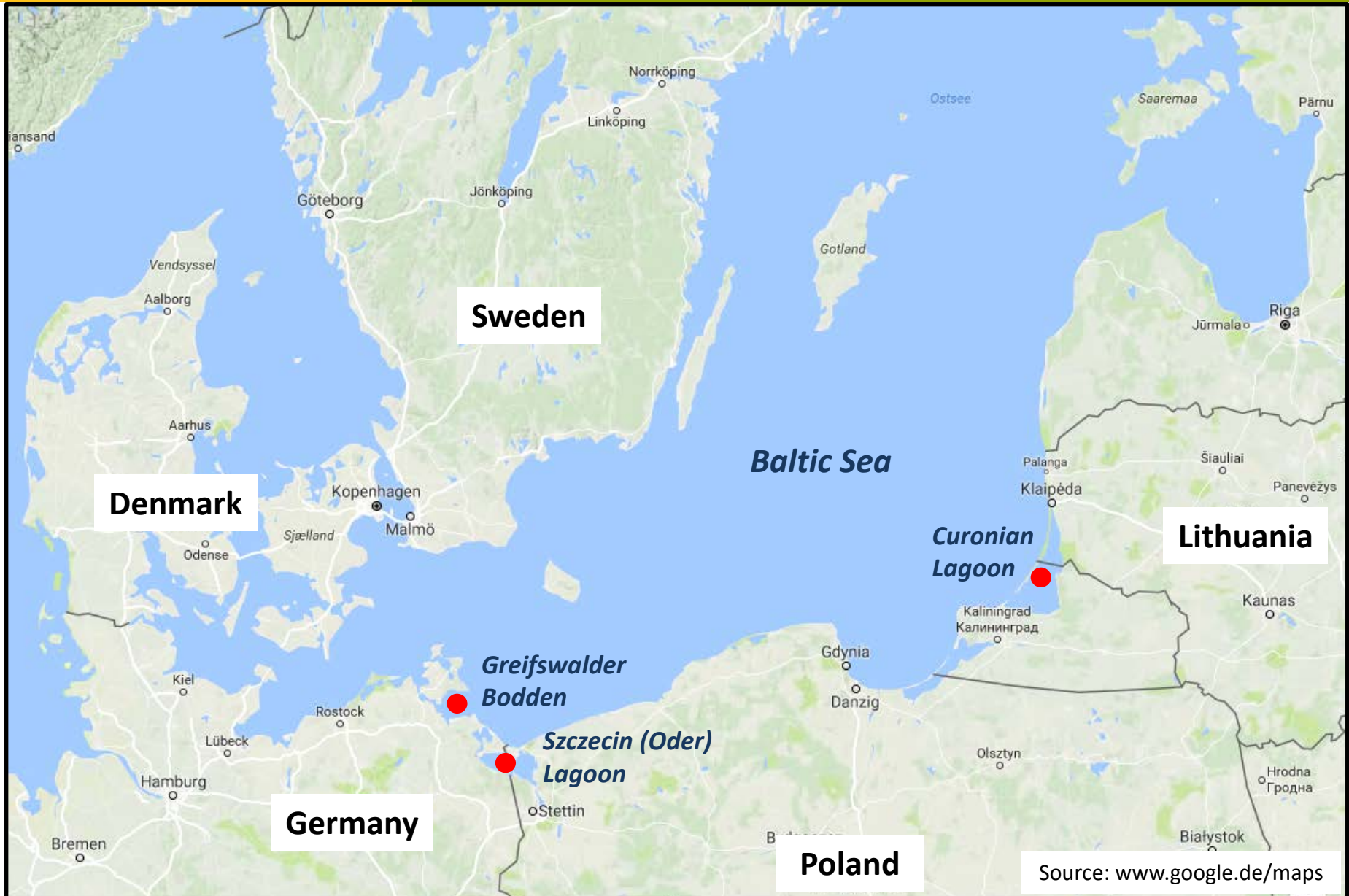
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**A SYSTEM APPROACH FRAMEWORK FOR
COASTAL RESEARCH & MANAGEMENT**



Baltic Sea - Greifswalder Bodden (Bay)





Landscape and uses

Coast, Lubmin



Natur reserve, Gager, Rügen



Gager, Rügen



Protected coast, Rügen



Spatial Planning Region - Vorpommern



<http://www.rpv-vorpommern.de/>

Population	463,178
Area (km ²)	7,137
Pop. Density (/km ²)	65

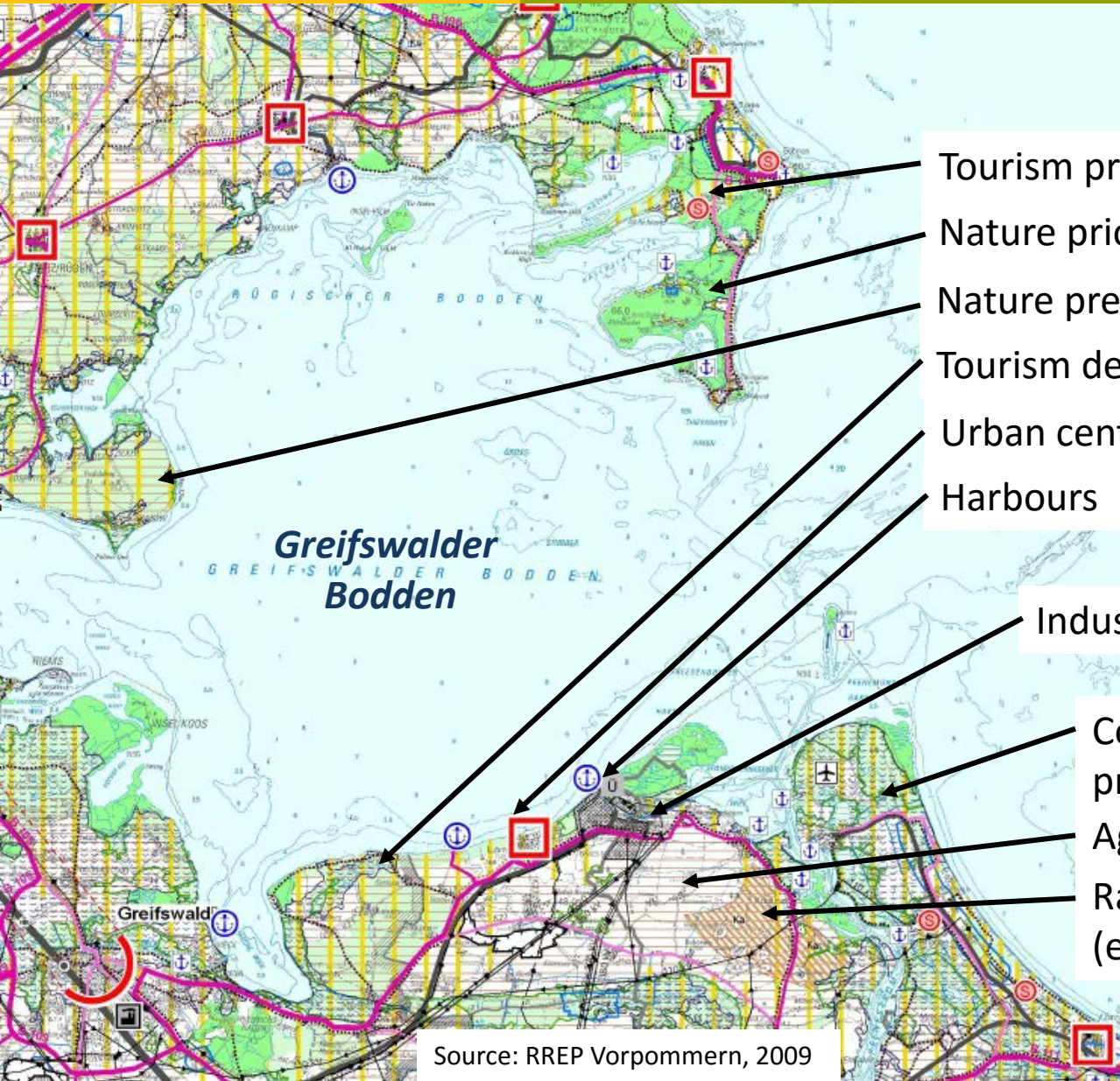
Tourism

Overnight stays	15 Mio.
Bed capacity	103,000
Seaside resorts	> 40





The Spatial Development Plan - replacing ICZM?



Tourism priority

Nature priority

Nature precaution

Tourism development

Urban center

Harbours

Industrial area

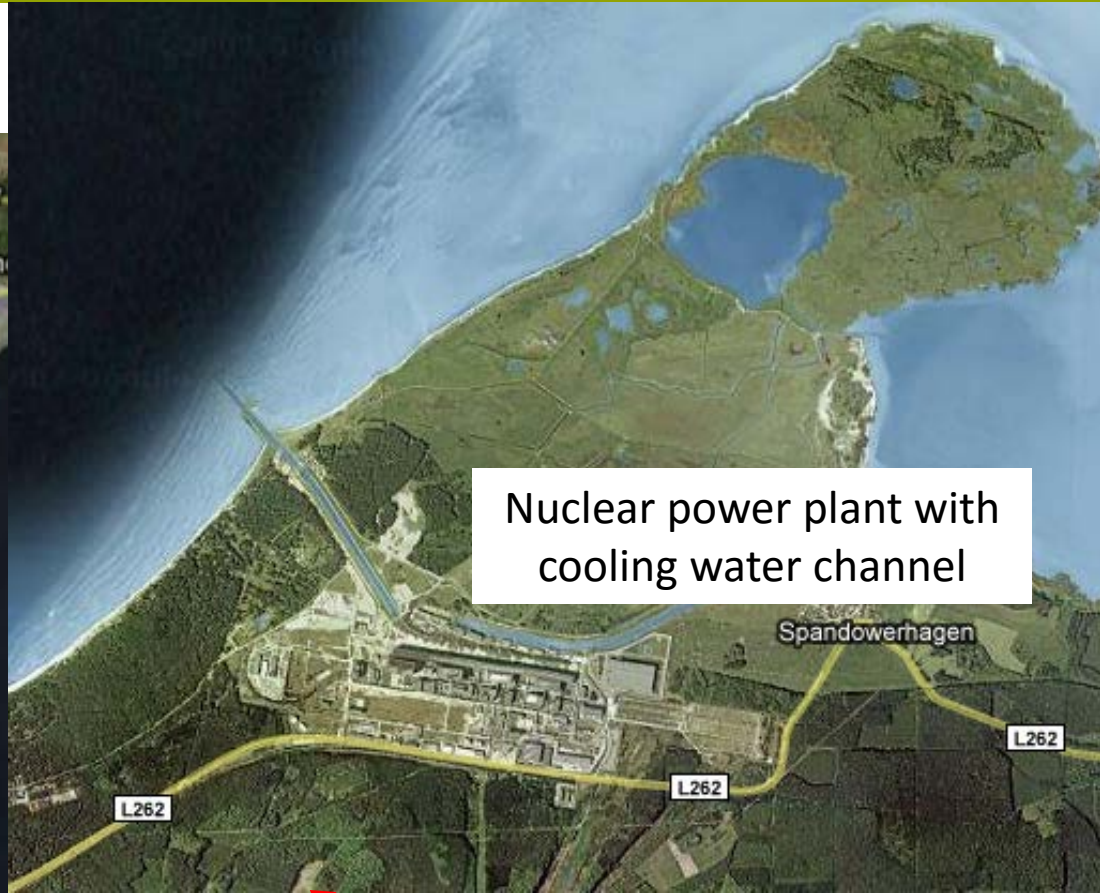
Coastal protection
precaution

Agriculture

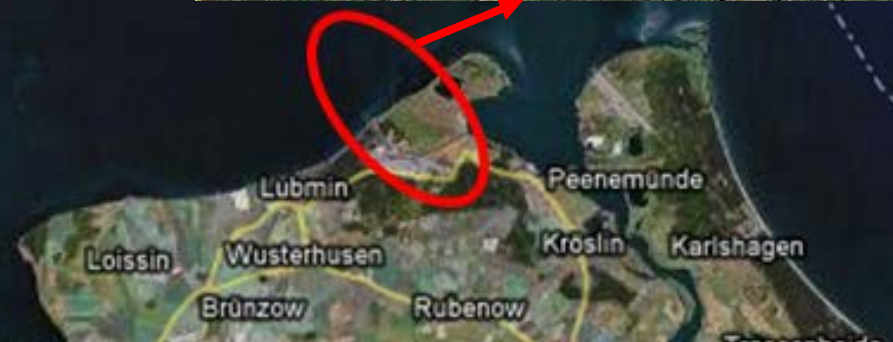
Raw material precaution
(e.g. sand, gravel)



Old industrial areas - a burden for Lubmin?



Nuclear power plant with cooling water channel





New industries – a brighter future for Lubmin

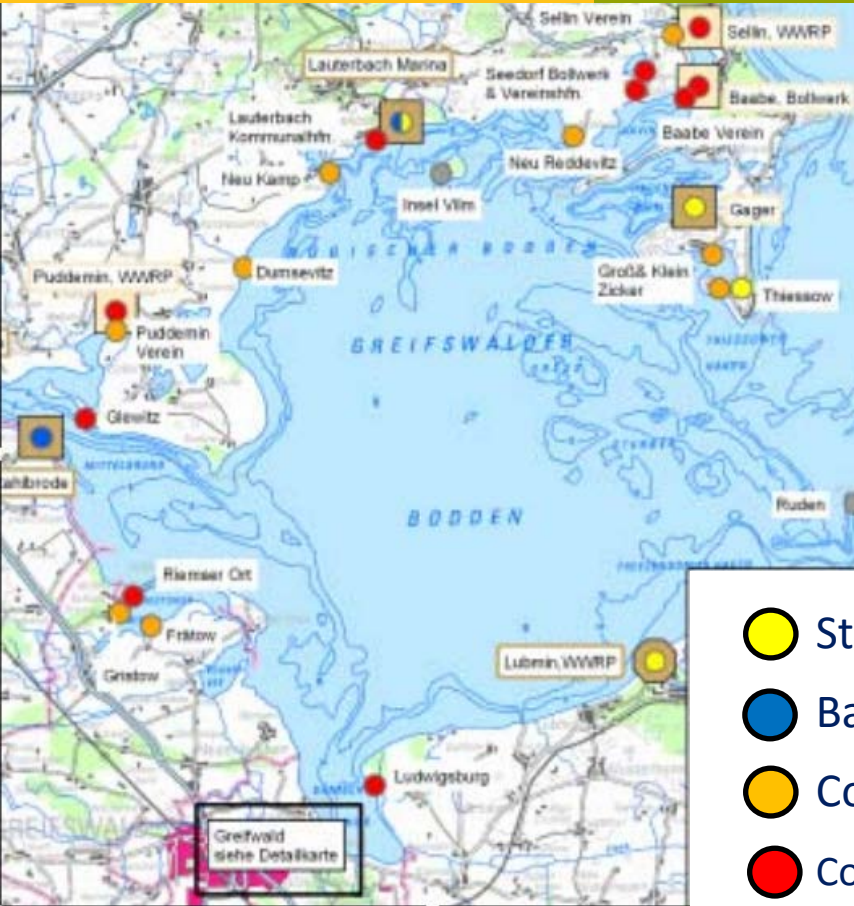


Industrial area & harbour near Lubmin





Sport-boat harbour developments



Harbour berths: 2960 (2003)
(demand) 4619 (2015)

- Stage harbour for visitors
- Base harbour
- Complementary harbour for larger boats
- Complementary harbour for small boats (<1.8 m)

2004

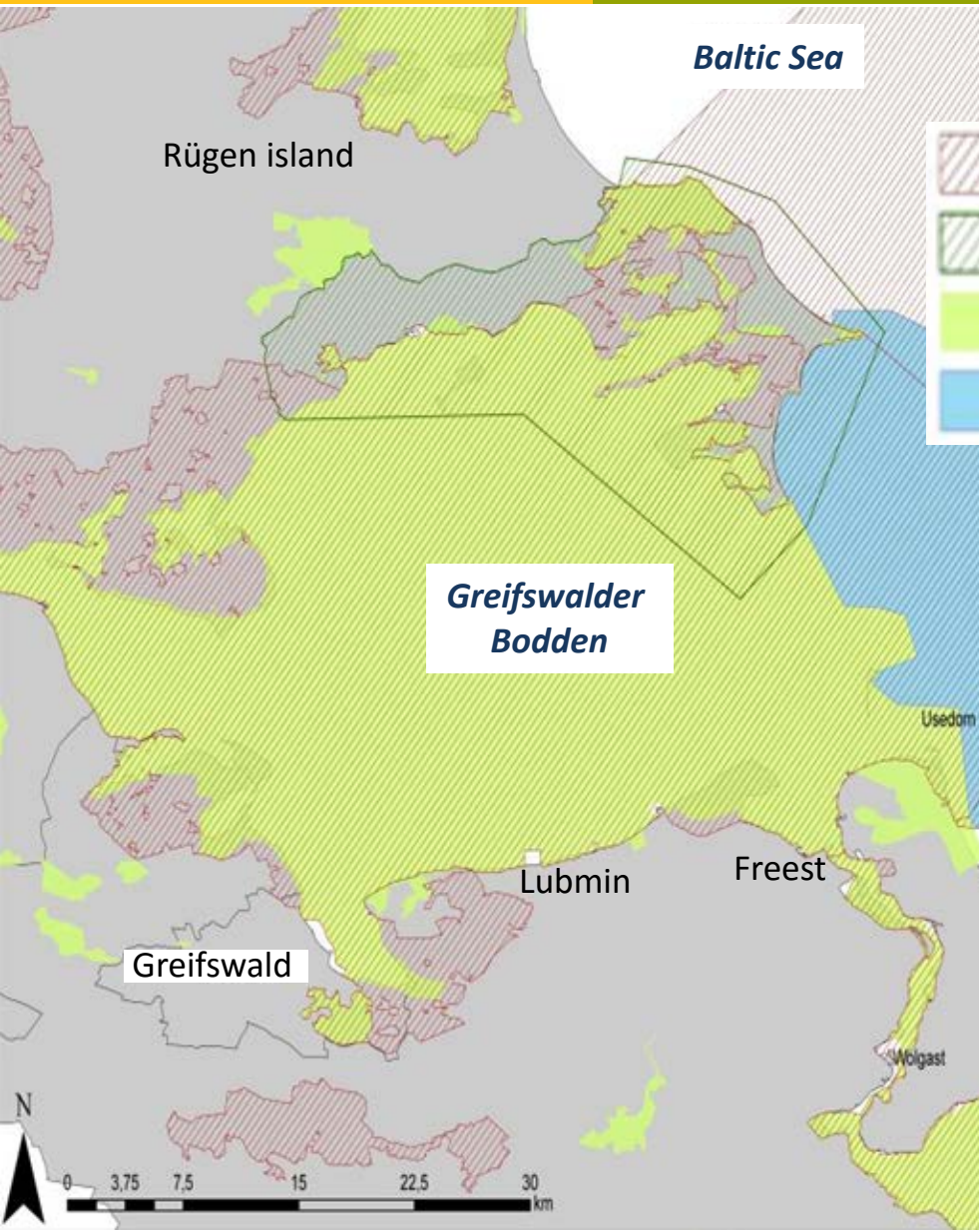
„Die Förderung des Wassersporttourismus durch die Erweiterung oder den Neubau von Sportboothäfen ist aus ökonomischer Sicht sinnvoll, da der Wassersport für die wirtschaftliche Entwicklung des Ostseeküstenraumes Mecklenburg-Vorpommerns aufgrund seines weiteren Wachstums und nicht ausgeschöpfter Potenziale weiter an Bedeutung gewinnen kann.“

Standortkonzept für
Sportboothäfen an der Ostseeküste





Nature protection of sea and coast



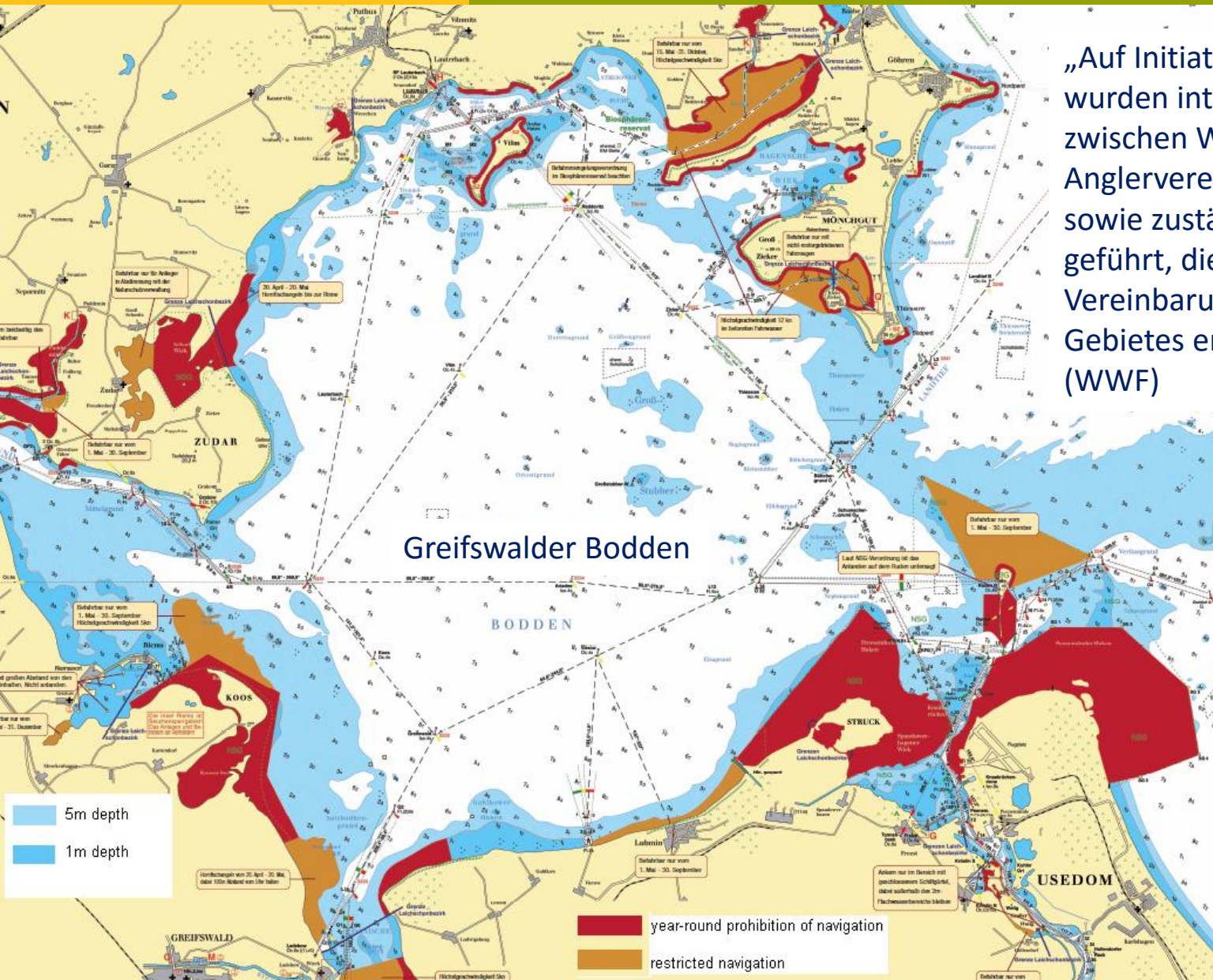
Legend

- Bird sanctuary
- Biosphere reserve
- FFH area
- FFH coastal area

Coast west of Lubmin



Nature protection & water-sports management



„Auf Initiative des WWF wurden intensive Gespräche zwischen Wassersport- und Anglervereinen der Region sowie zuständigen Behörden geführt, die eine freiwillige Vereinbarung zur Nutzung des Gebietes erbracht haben“ (WWF)



Fisheries – does it have a future?



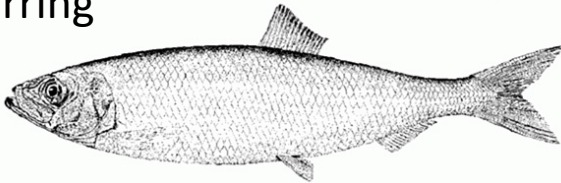
About 50 fishermen! Smoking, frying and fish-restaurants help to increase local benefits from fisheries



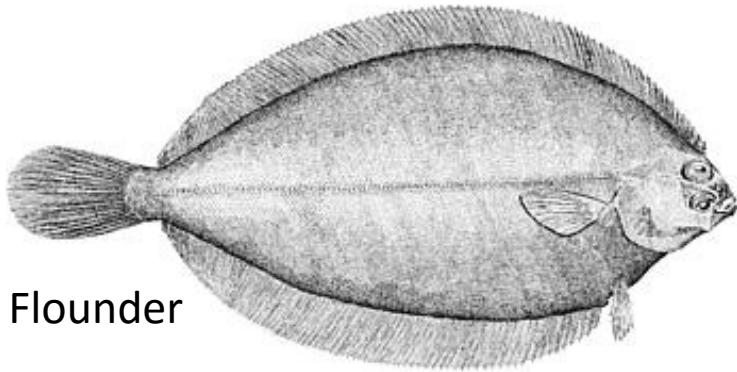


Species composition of fish catches (2000-2006)

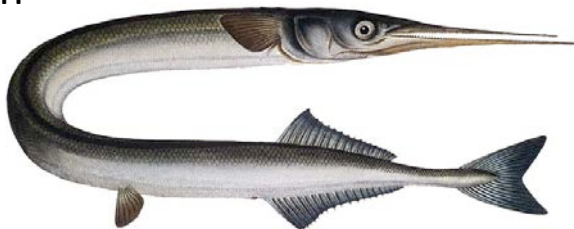
Herring



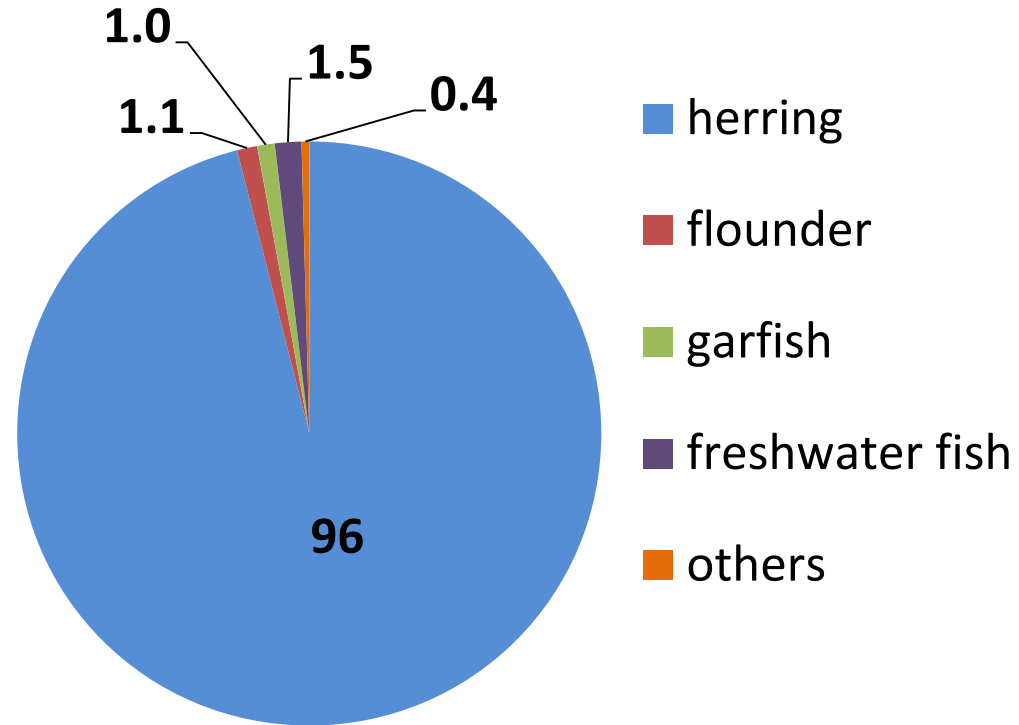
Flounder



Garfish



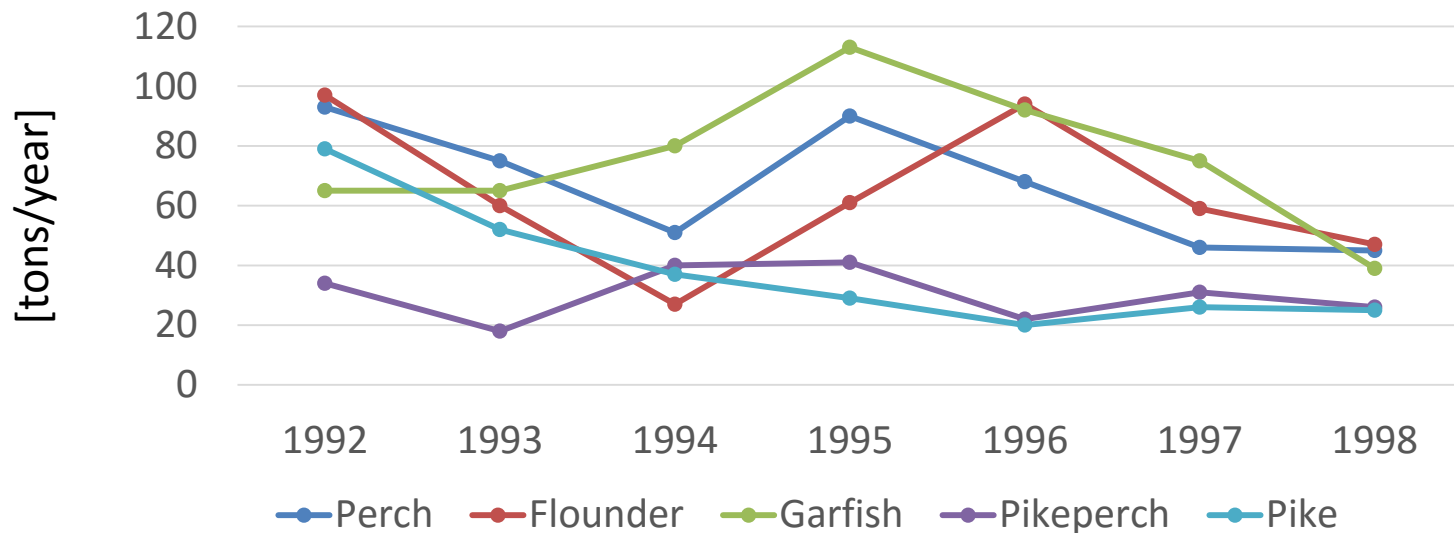
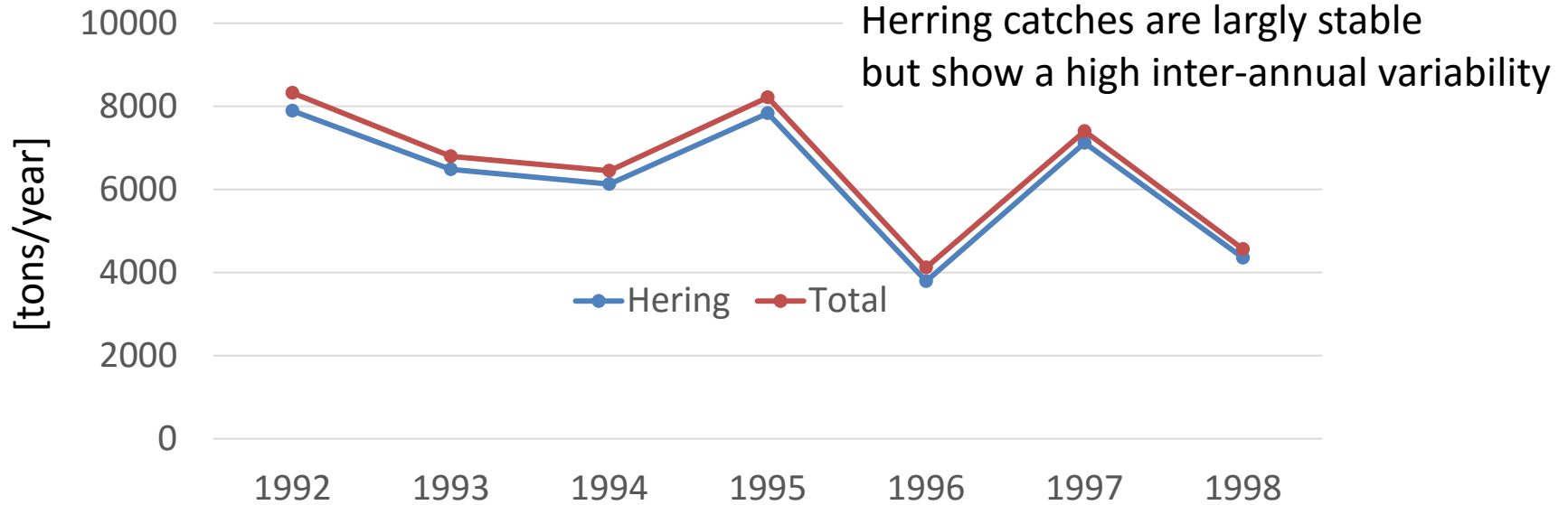
Greifswalder Bodden Catches of fish species [%]



13 marine, 11 freshwater and 7 migrating fish species are commercially used

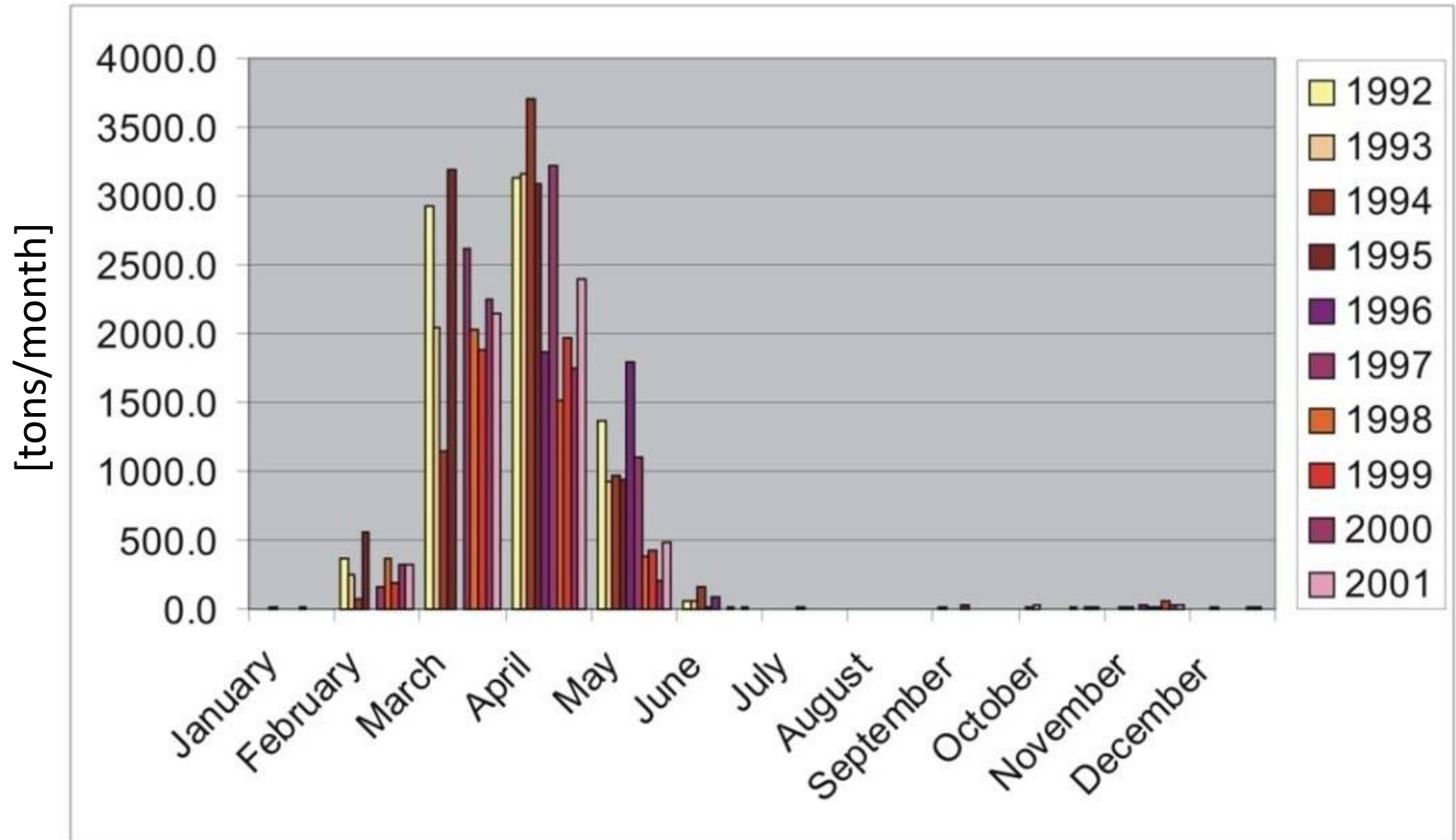


Greifswalder Boden – Fish catches (1992-1998)





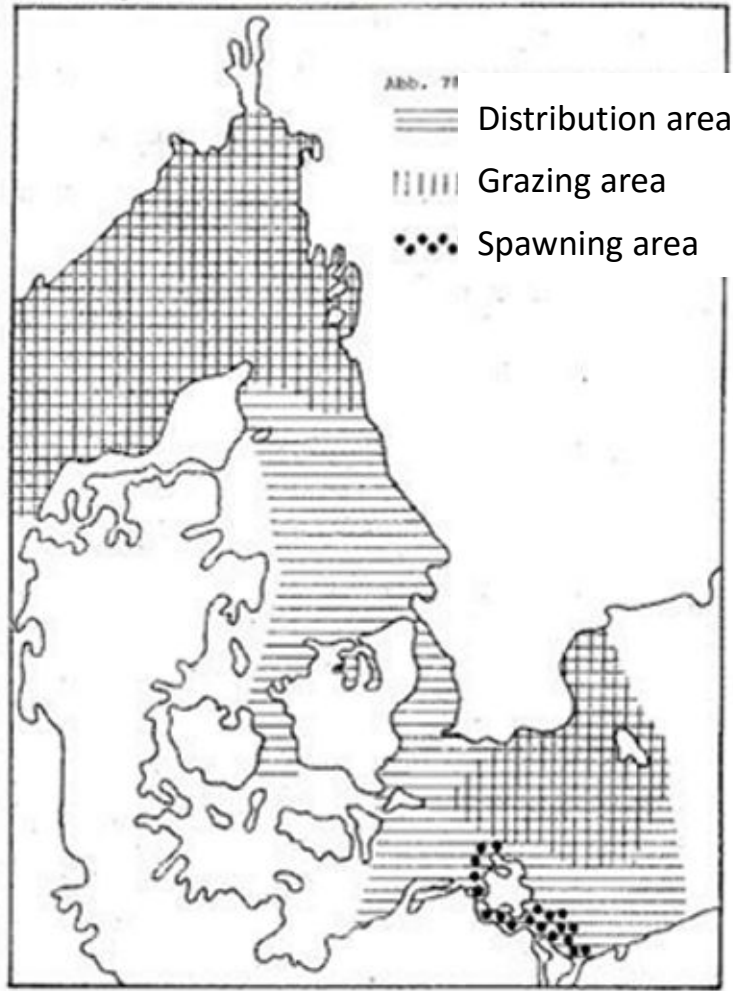
Herring – seasonal catches



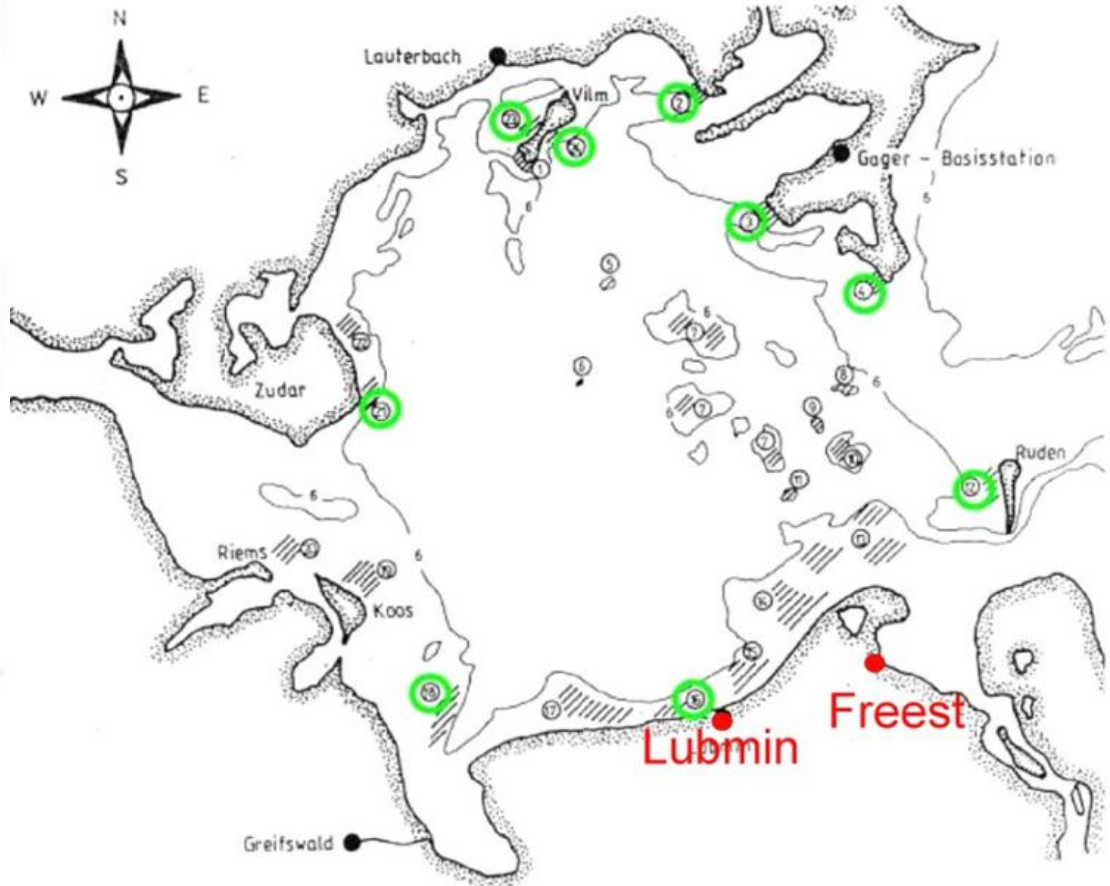
(Source: Gröhsler 2003)



Herring: Spatial distribution and spawning areas



(Vietinghoff, 1994)



○ area of specific importance for spawning of herring

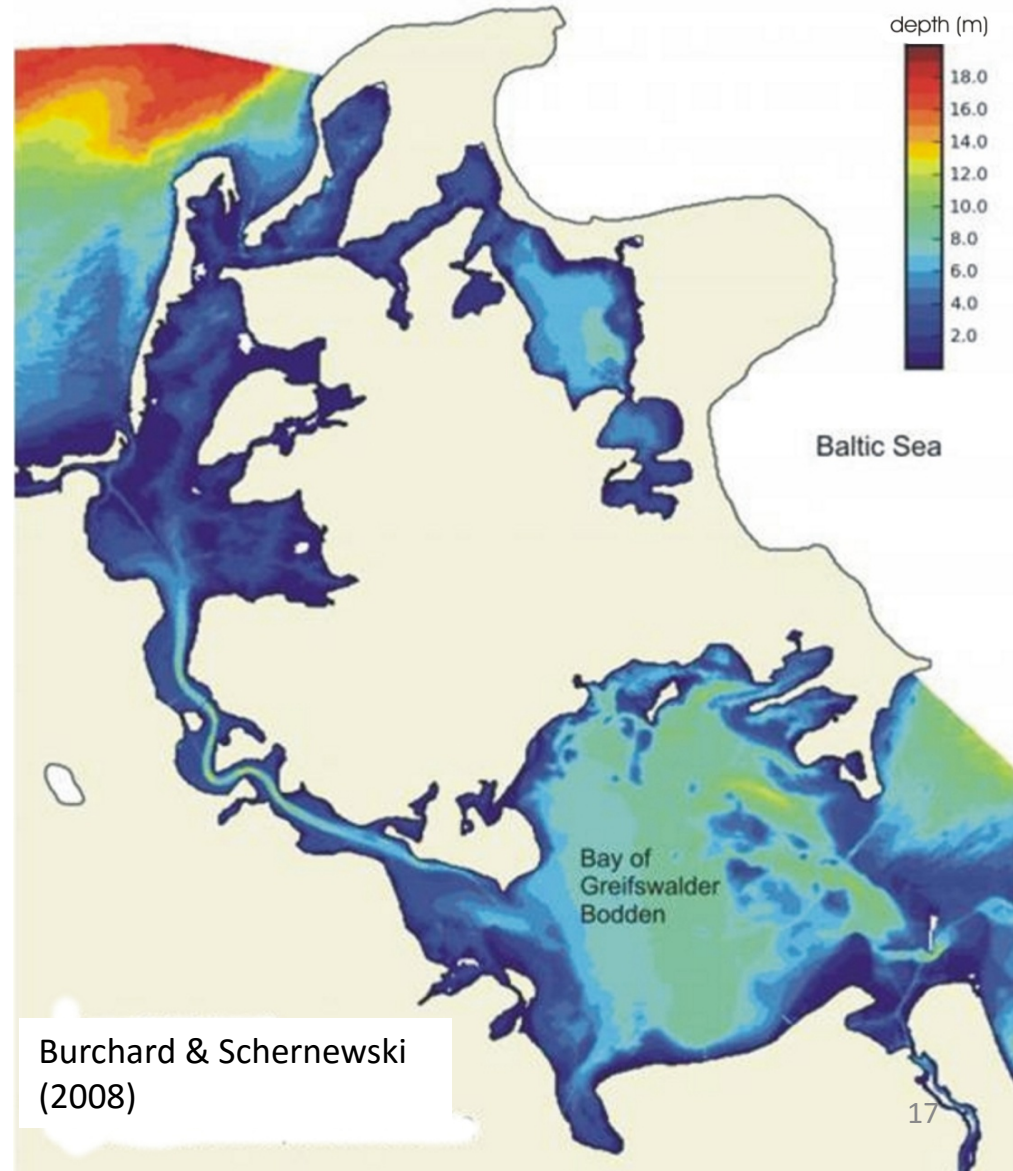
○ potential spawning area for herring

(Scabell, 1988)



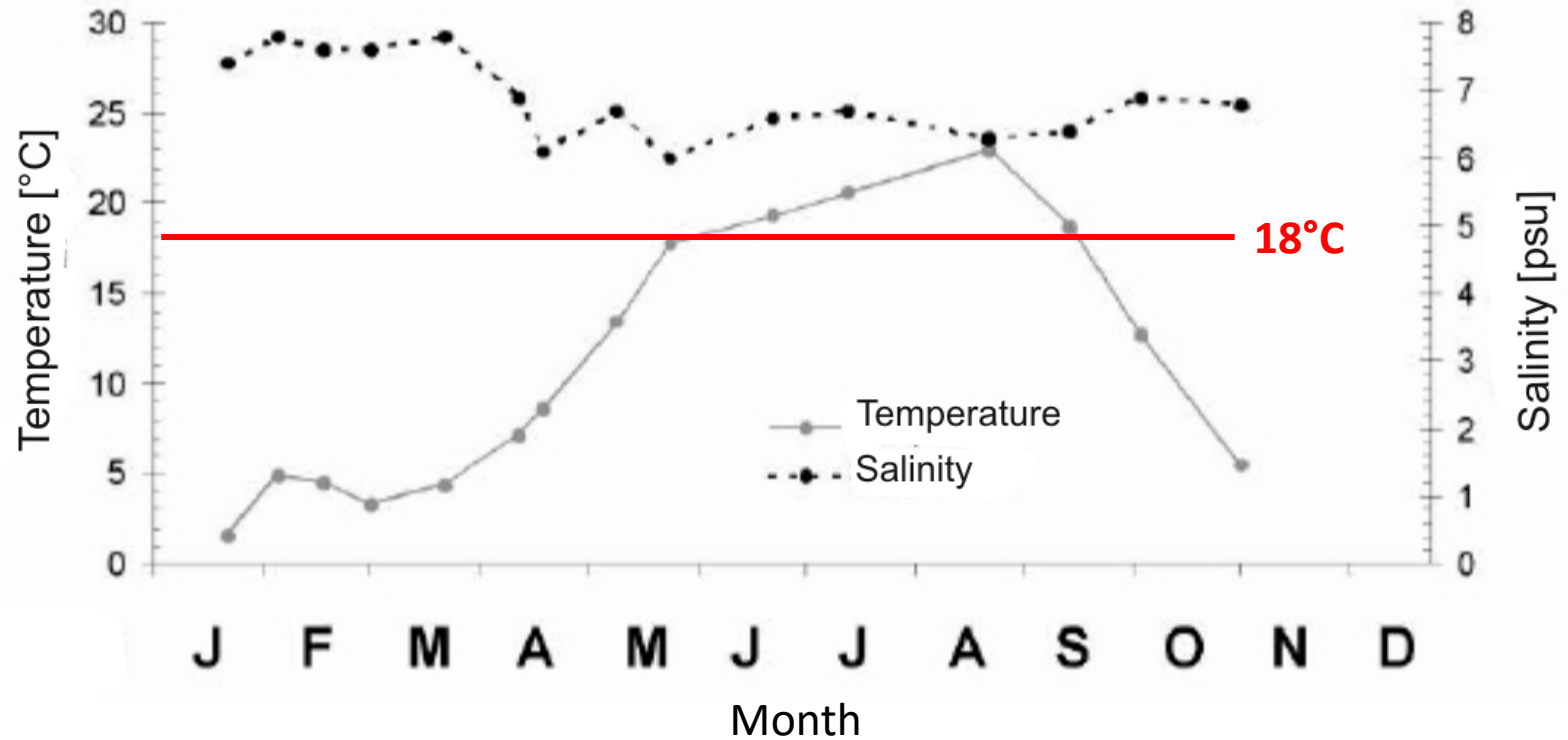
Greifswalder Bodden – a shallow coast water

- Surface area: 514 km²
- Diameter: 25 km
- Average depth: 5.8 m
- Maximum depth: 13.5 m
- Water exchange rate 8-17 times/year





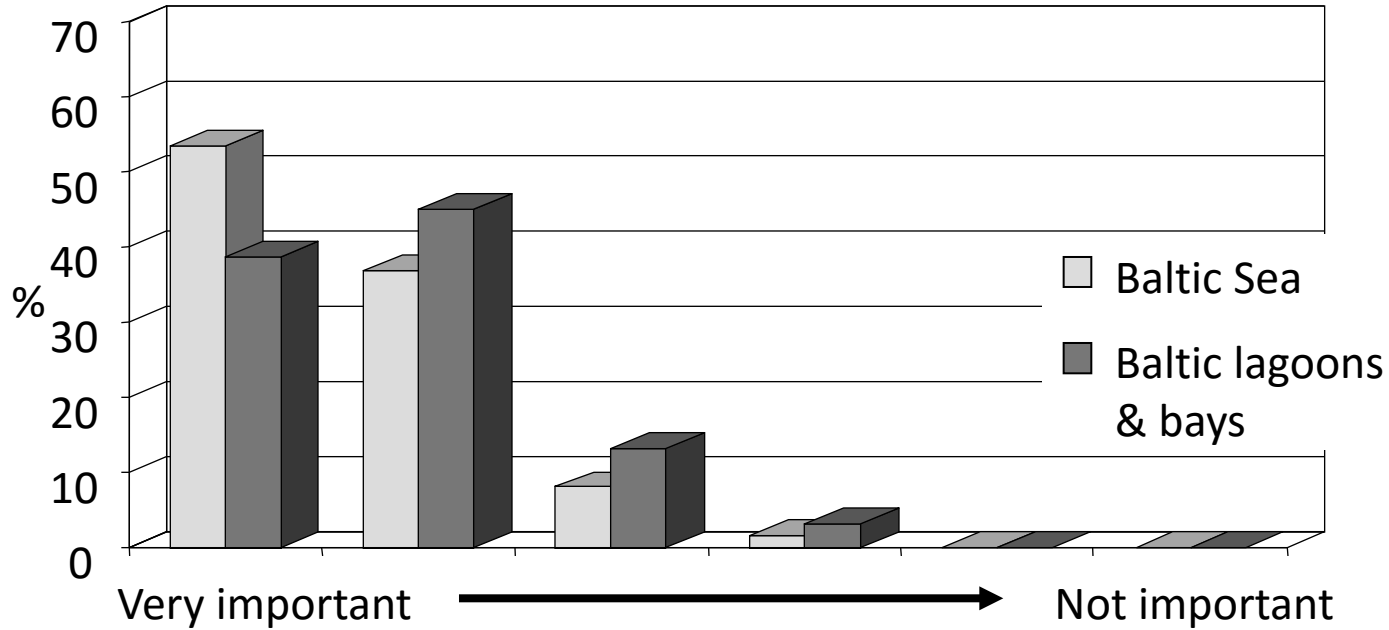
Temperature and salinity



Source: LUNG Küstengewässermonitoring 2002.



Water quality: Importance for tourists





Water quality - Bathing waters (2010-2015)



Bathing water quality

- Excellent water quality
- Good water quality
- Sufficient water quality
- Poor water quality



New risk for bathing waters?

„Mann stirbt an Infektion Fleischfressende Bakterien! Wird das Baden in der Ostsee bald zur tödlichen Gefahr?“ (2014, FOCUS-Online)

„Wie gefährlich das Baden in der Ostsee jetzt ist - Immer wieder sorgen angebliche Killerkeime im Meer für Schlagzeilen. (Welt 2015)

*„Wie schütze ich mich vor den Killer-Bakterien?“
(Bild 2014)*

*“...wound infections after contact with the Baltic Sea, Germany”
(Eurosurveillance, 2006)*

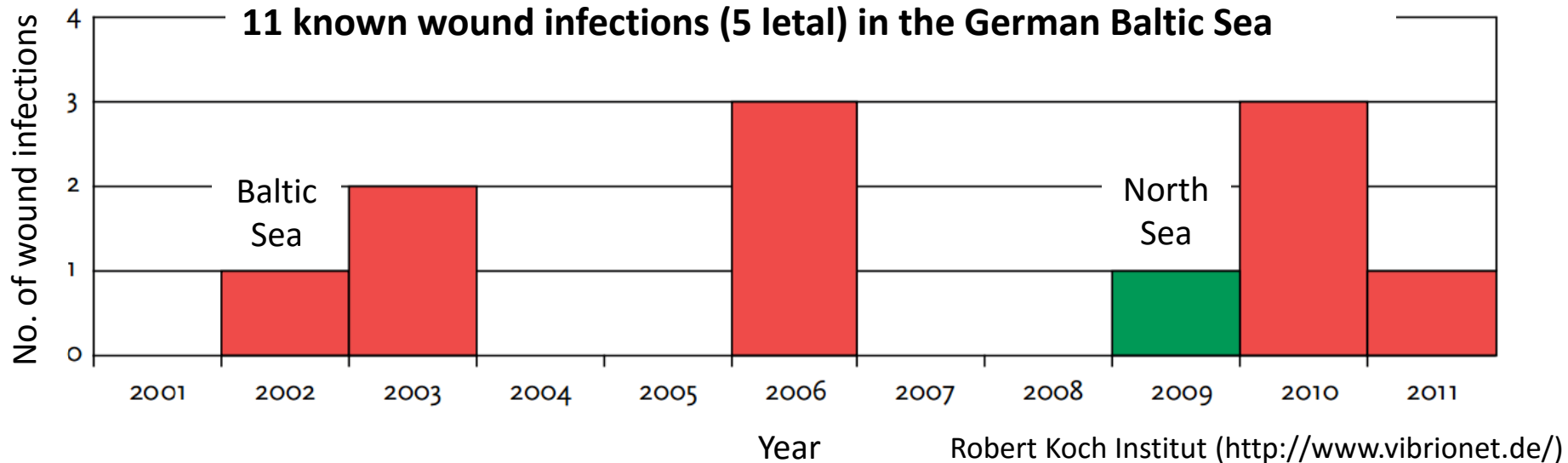
“Emerging ... risk at high latitudes in response to ocean warming” (Nature, 2012)



Ito et al. (2012) Journal of Diabetes Mellitus



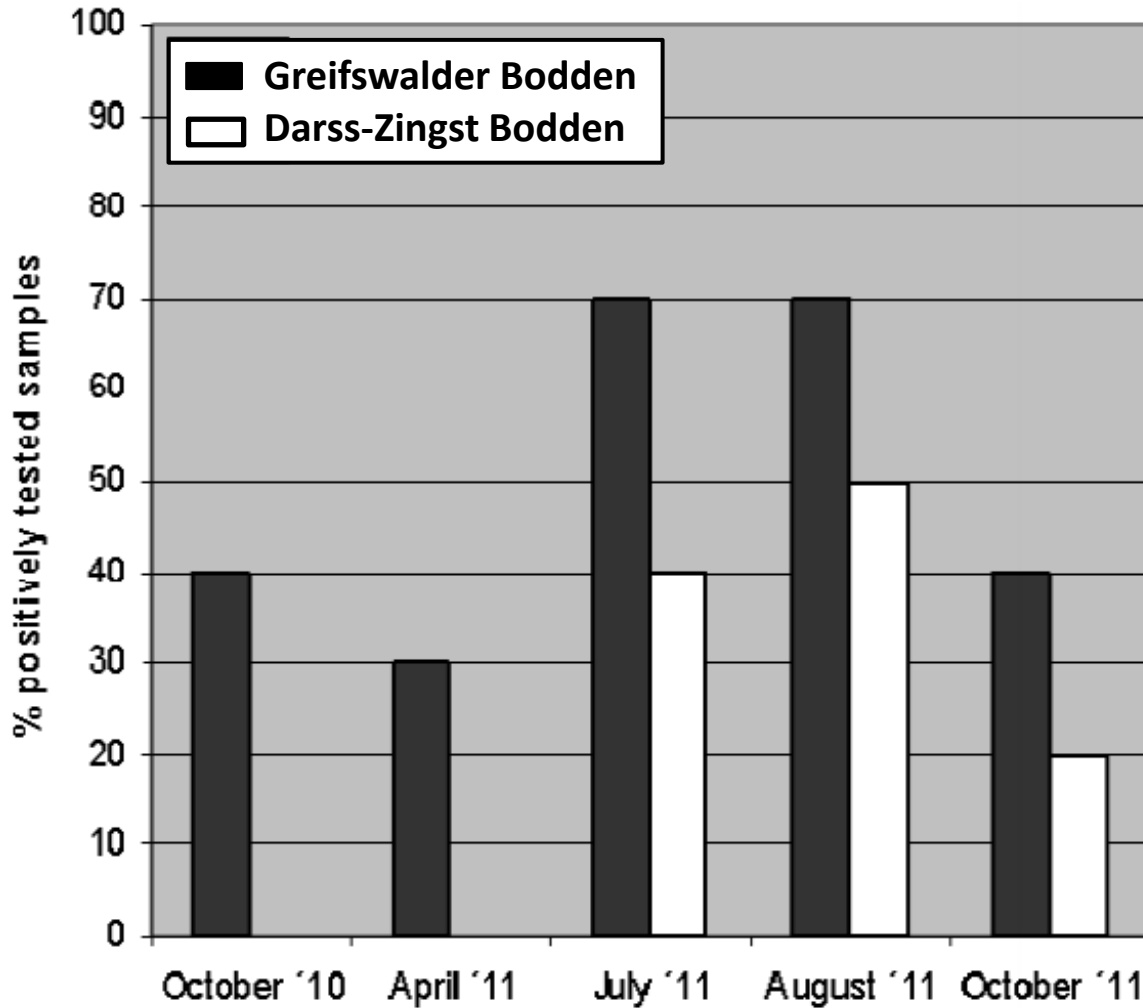
Vibrions – a recent risk?



- *Vibrio vulnificus* close relative of *Vibrio cholerae*
- *Vibrio vulnificus* is occurring naturally in brackish and sea water
- Concentration growing rapidly at water temperatures above 20°C
- Disease characterized by severe infection of wounds and sepsis

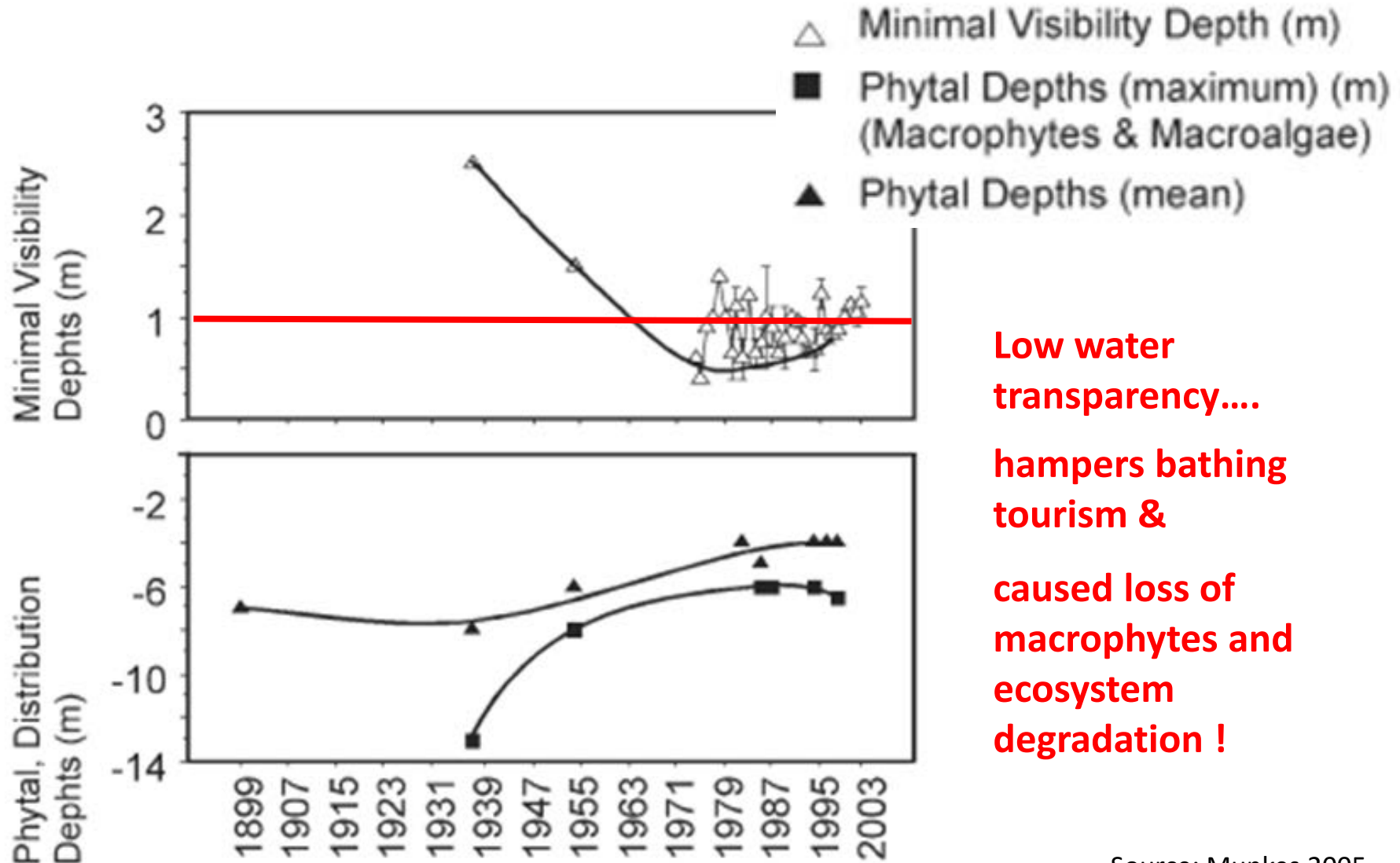


Greifswalder Bodden – *Vibrio vulnificus*





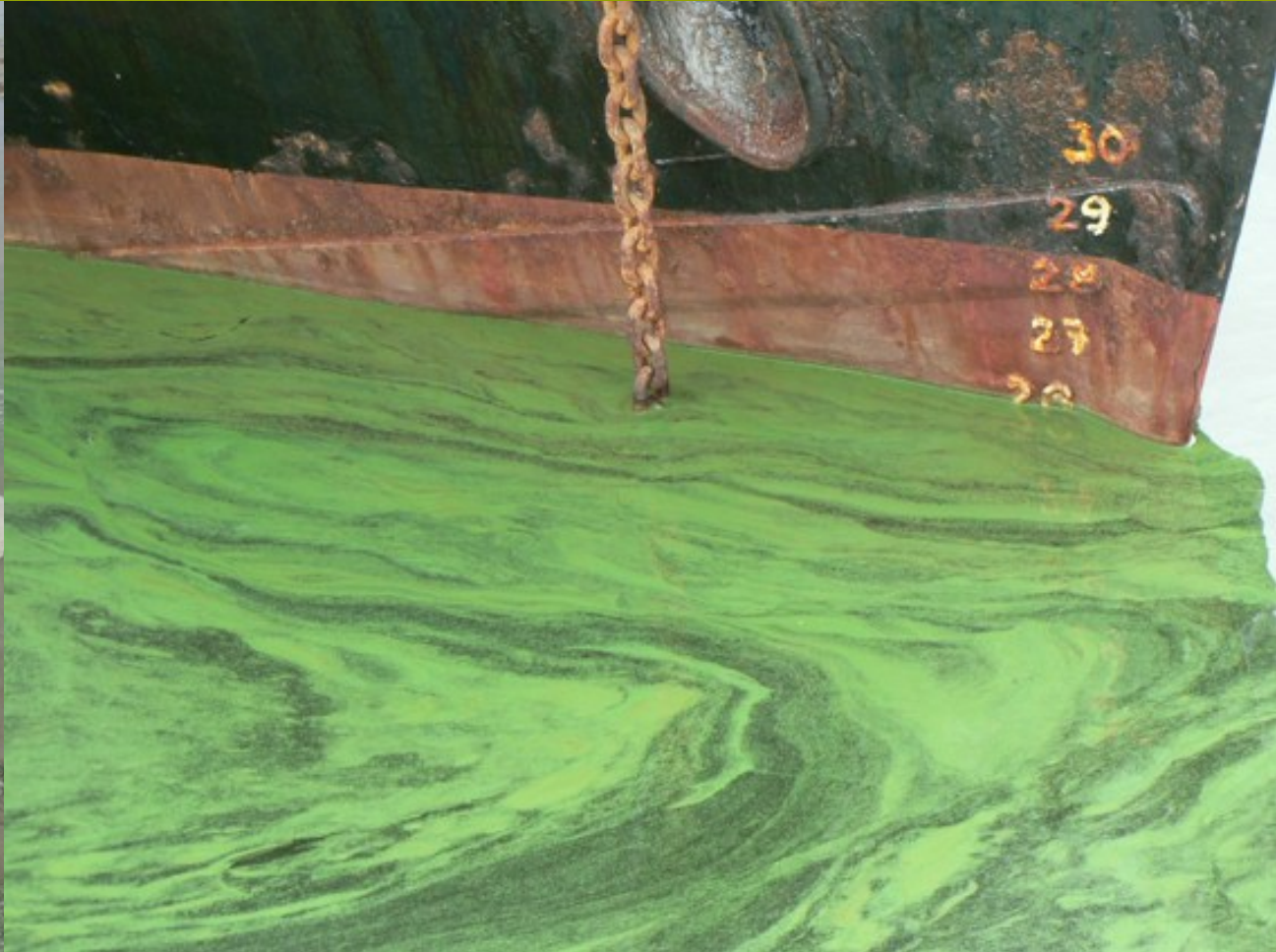
Water quality - eutrophication & water transparency



Low water transparency.... hampers bathing tourism & caused loss of macrophytes and ecosystem degradation !



Eutrophication and algae blooms



In summer, cyanobacteria are predominant e.g. *Anabaena sp.* and *Mycrocystis ssp.* less often *Nodularia spumigena*



Cyanaobacteria – events, species and toxicity

Time	Location	Toxic species	Victim	Reference
July 1963	Kleiner Jasmunder Bodden (Rügen)	<i>Nodularia spumigena</i> , <i>Microcystis flos-aquae</i>	340 ducks	Pankow (1964), Kalbe and Tiess (1964)
Aug 1983	Strelasund (German coast)	<i>Nodularia spumigena</i>	76 young cattle ill, 16 died within 12-24 h	Gußmann et al. (1985)

Type of toxicity	Toxins	Accumulation in:	Symptoms
Hepatotoxin (HT)	nodularin, microcystin etc.	water, (shellfish ?)	Stupor, spasm, convulsions, unconscious-ness; death by causing blood to pool in the liver. This pooling can lead to circulatory shock within a few hours or lead over several days to death by liver failure. Non-lethal doses might contribute to cancer.
Neurotoxin (NT)	anatoxin	water, shellfish	Muscle twitching and cramping, followed by fatigue and paralysis; may cause death within minutes by paralysis of the respiratory muscles.



What happened?



Lake Neuwarp, Oder Lagoon, August 2016



Greifswalder Bodden – biomass of mussel species



Mytilus Edulis
(blue mussel)



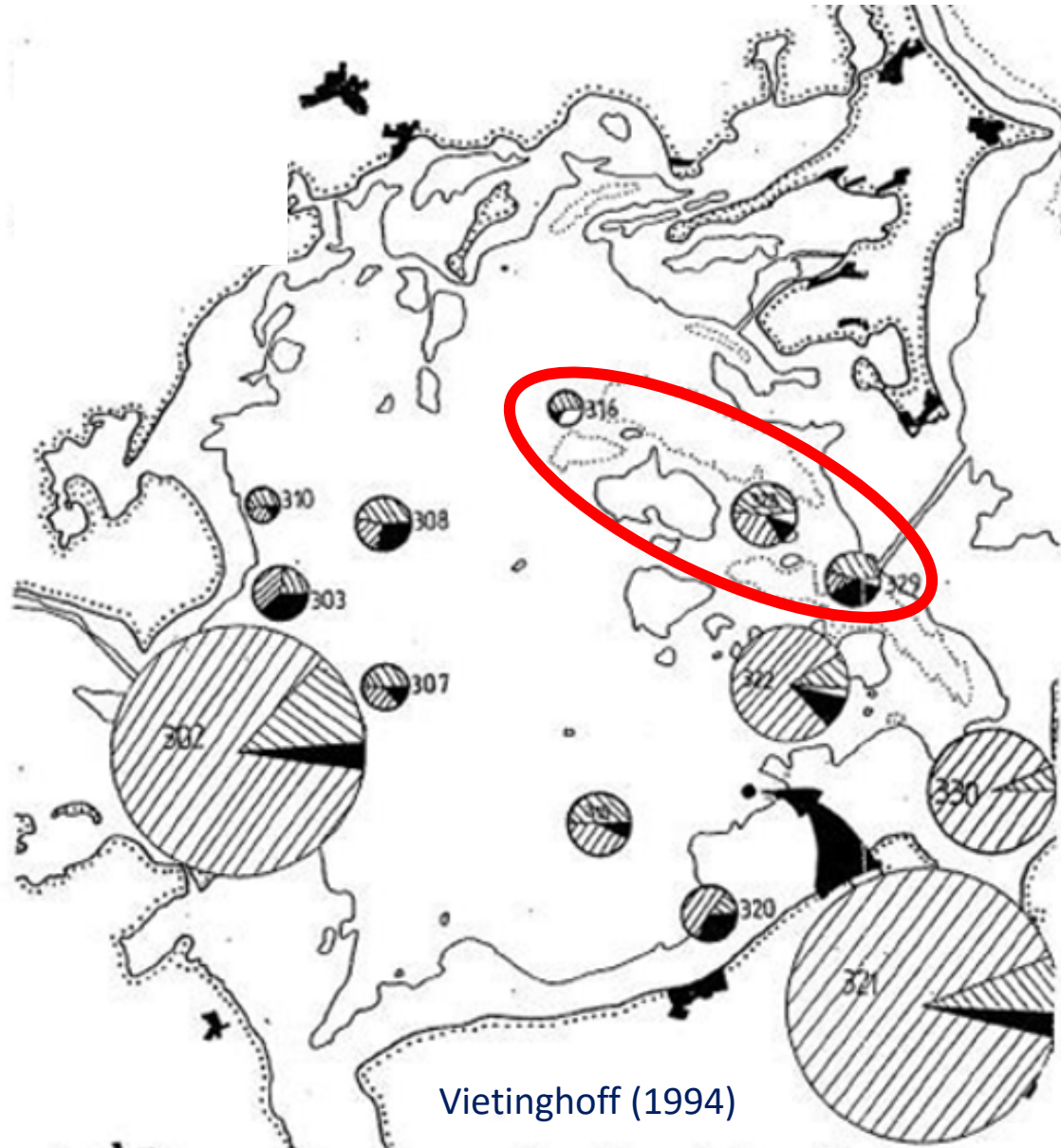
Macoma balthica



Arenomya arenaria

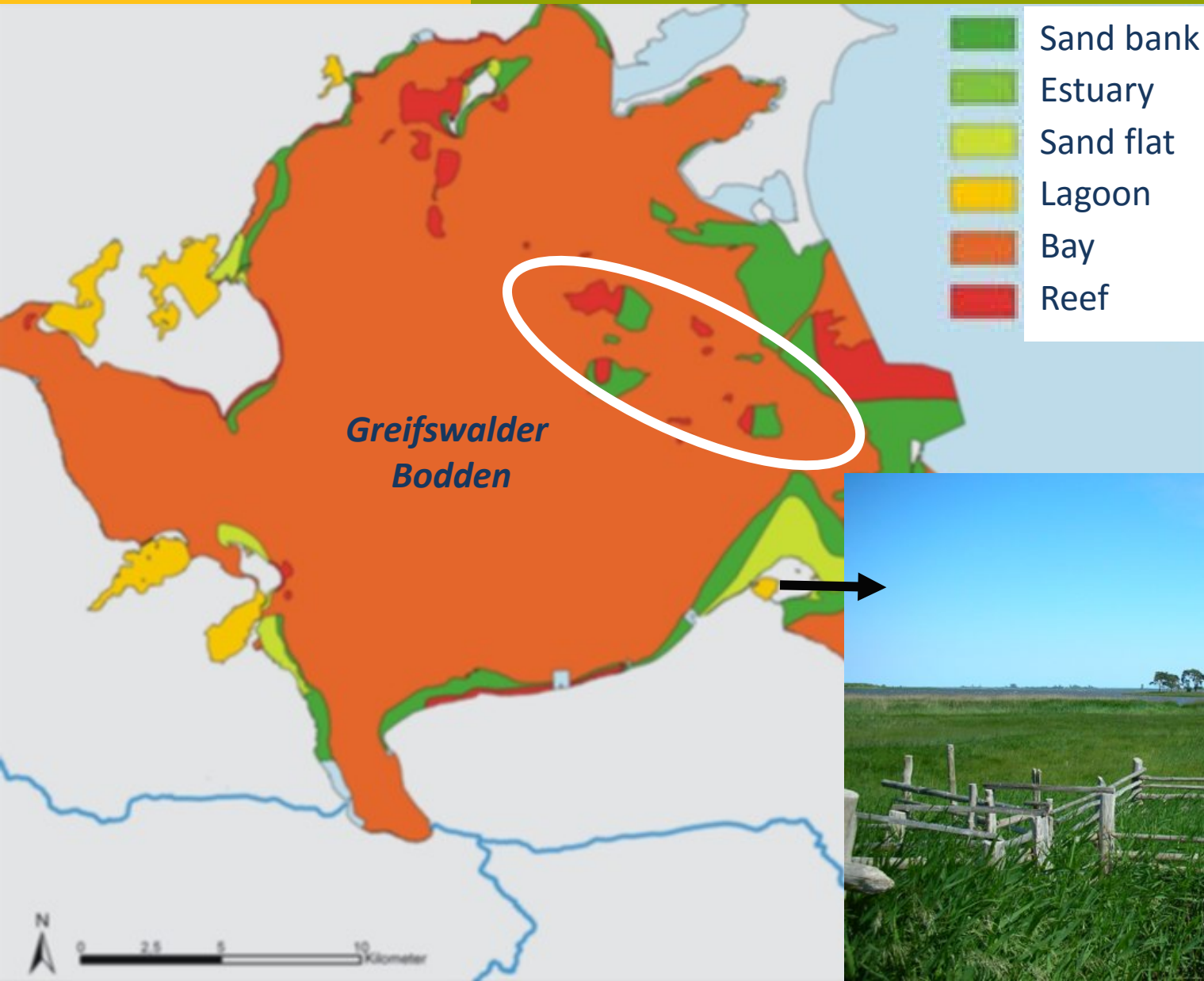


Cerastoderma lamarcki





Nature protection – water habitat types



Thank you for your attention !

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