

# Response of marine ecosystems to multiple drivers in the Baltic Sea

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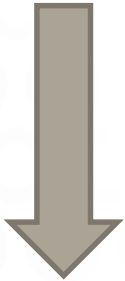


S Y K E

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# How do we define "Response of marine ecosystems to multiple drivers"?

PRESSURE



ECOSYSTEM

- ❑ Each pressure produces multiple effects on the ecosystem
- ❑ Ecosystem is typically defined by key species, habitats and functions
- ❑ Multiple pressures with multiple ecosystem features produces a matrix too complex for data analyses (at least currently)



# How the ecosystem responses were surveyed?

HELCOM-coordinated surveys to national experts:

- Sensitivity (tolerance, recoverability)
- Self-assessment of confidence

Guidelines and helpdesk...

Focus on EU MSFD pressures.



# How the ecosystem responses were surveyed?

**HOLAS I (2009): HELCOM survey and a workshop.**

**ODEMM (2012): 4 regional workshops.**

**HOLAS II (2016): HELCOM survey (81 experts from nine countries).**

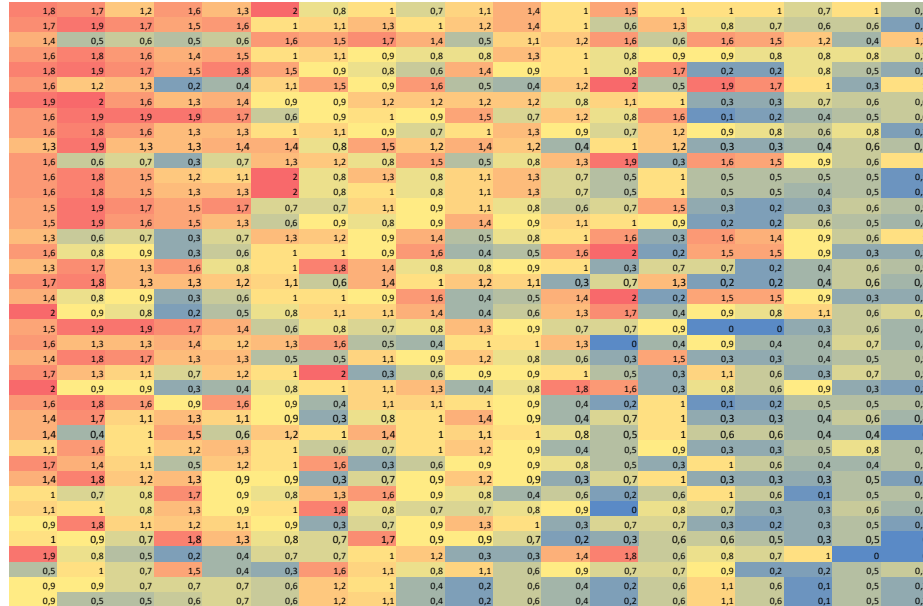
**EEA/ETC-ICM survey: 54 experts from 4 regional seas (+ HOLAS II).**



# The most sensitive features in the Baltic Sea?

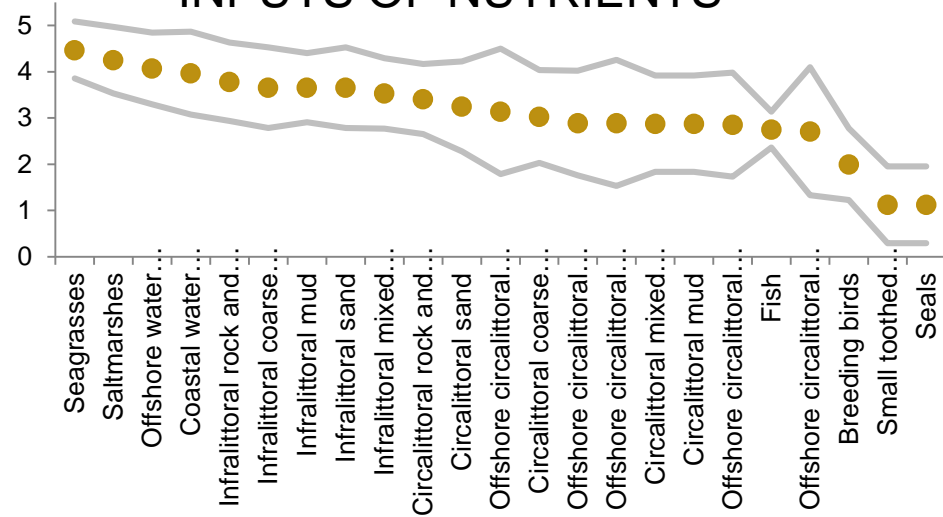
OIL SPILLS  
PHYSICAL LOSS  
PHYSICAL  
DISTURBANCE  
NUTRIENTS

STRUCTURES WITH LEAKING GASES  
COASTAL LAGOONS  
RINGED SEAL DISTRIBUTION  
ESTUARIES  
MUDFLATS AND SANDFLATS  
HARBOUR PORPOISE  
REEFS  
EELGRASS

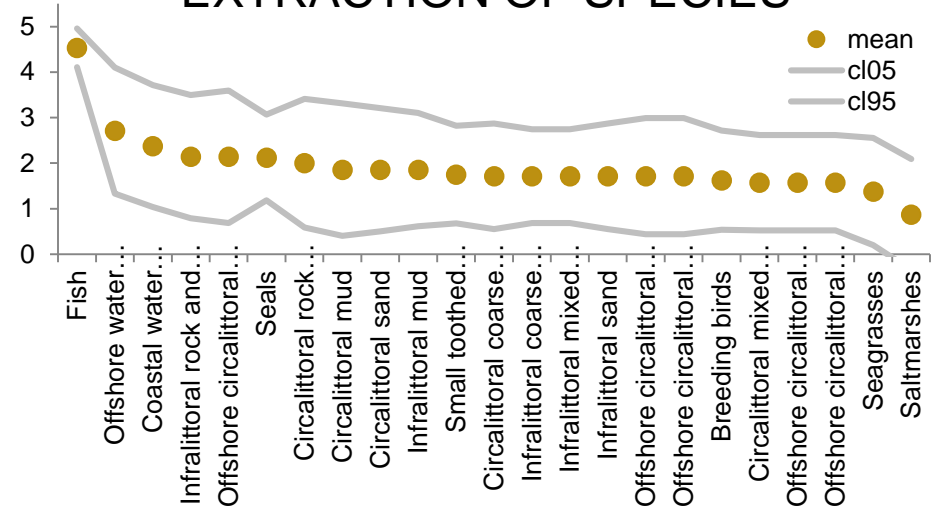


# How well do experts agree on ecosystem responses?

## INPUTS OF NUTRIENTS



## EXTRACTION OF SPECIES

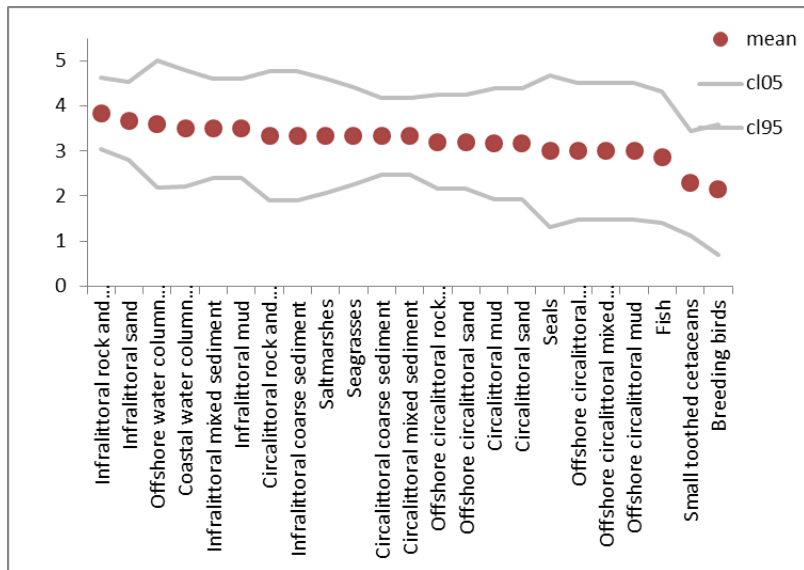




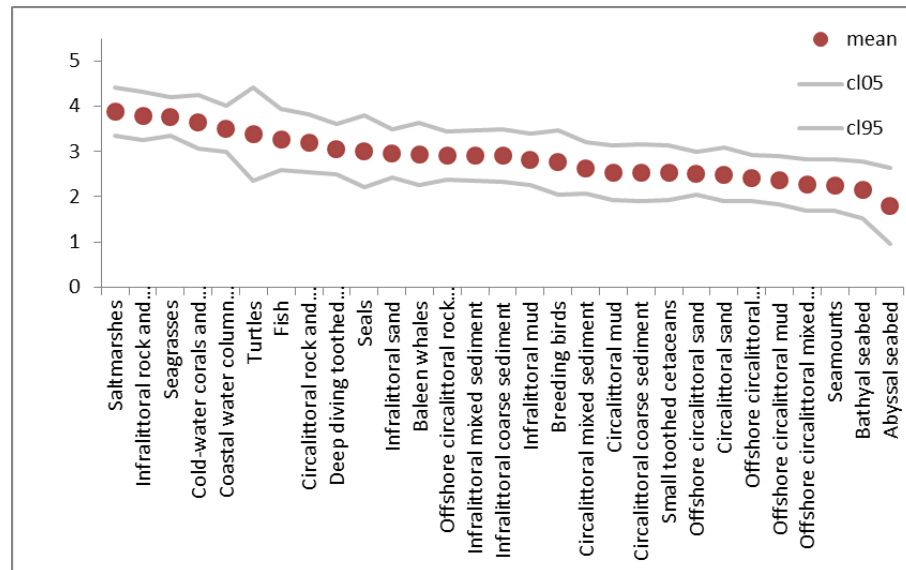
# How well do experts agree on ecosystem responses?

## WARMING OF SURFACE WATERS

### BALTIC SEA

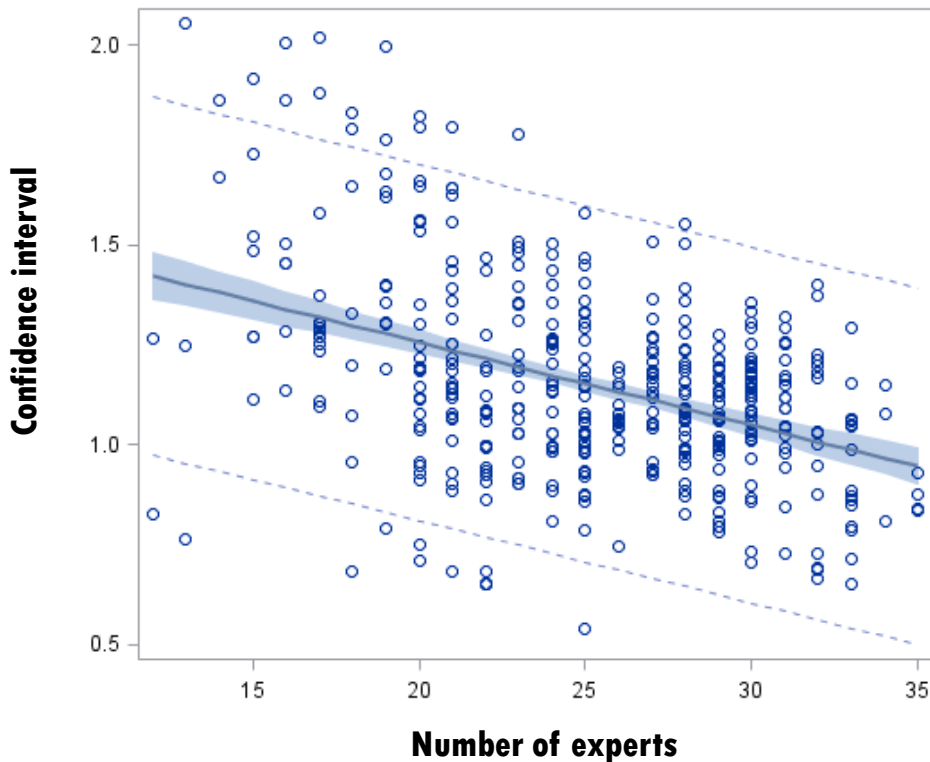


### WHOLE EUROPE





# Can we improve the prediction?



Increasing number of experts may improve the accuracy

Experts' self-assessment of confidence did not correlate with variability in responses

Accuracy of expert elicitation likely arises from

- clear guidance,
- unambiguous understanding of the task, and
- well-established theory of the responses.

# Are there differences in ecosystem sensitivity between marine regions?

European Topic Centre on Inland, Coastal and Marine Waters (ETC-ICM): survey to 54 experts in 4 marine regions

383 of 420 combinations showed statistically similar sensitivity ( $p > 0.05$ )

Most differences were found among:

- Extraction of species by commercial fishing
- Physical loss of seabed
- Introductions of alien species
- Input of microbial pathogens
- Changes to hydrological conditions
- Disturbance of species due to human presence

**There is a need for a coherent view of ecosystem responses to climate-related pressures.**

