

Large and medium scale spatial variability in biomarker responses in herring (*Clupea harengus membras*), a commercially and ecologically important fish species in the Baltic Sea

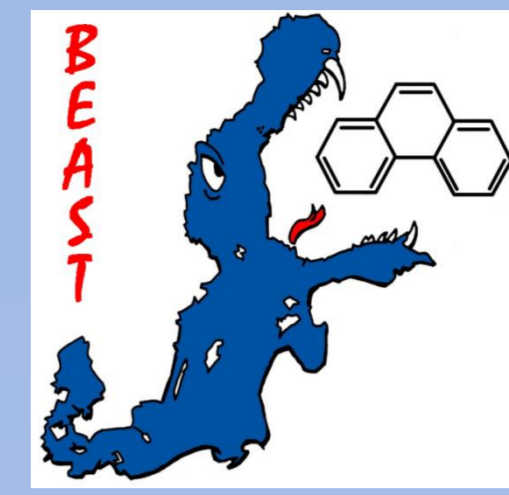


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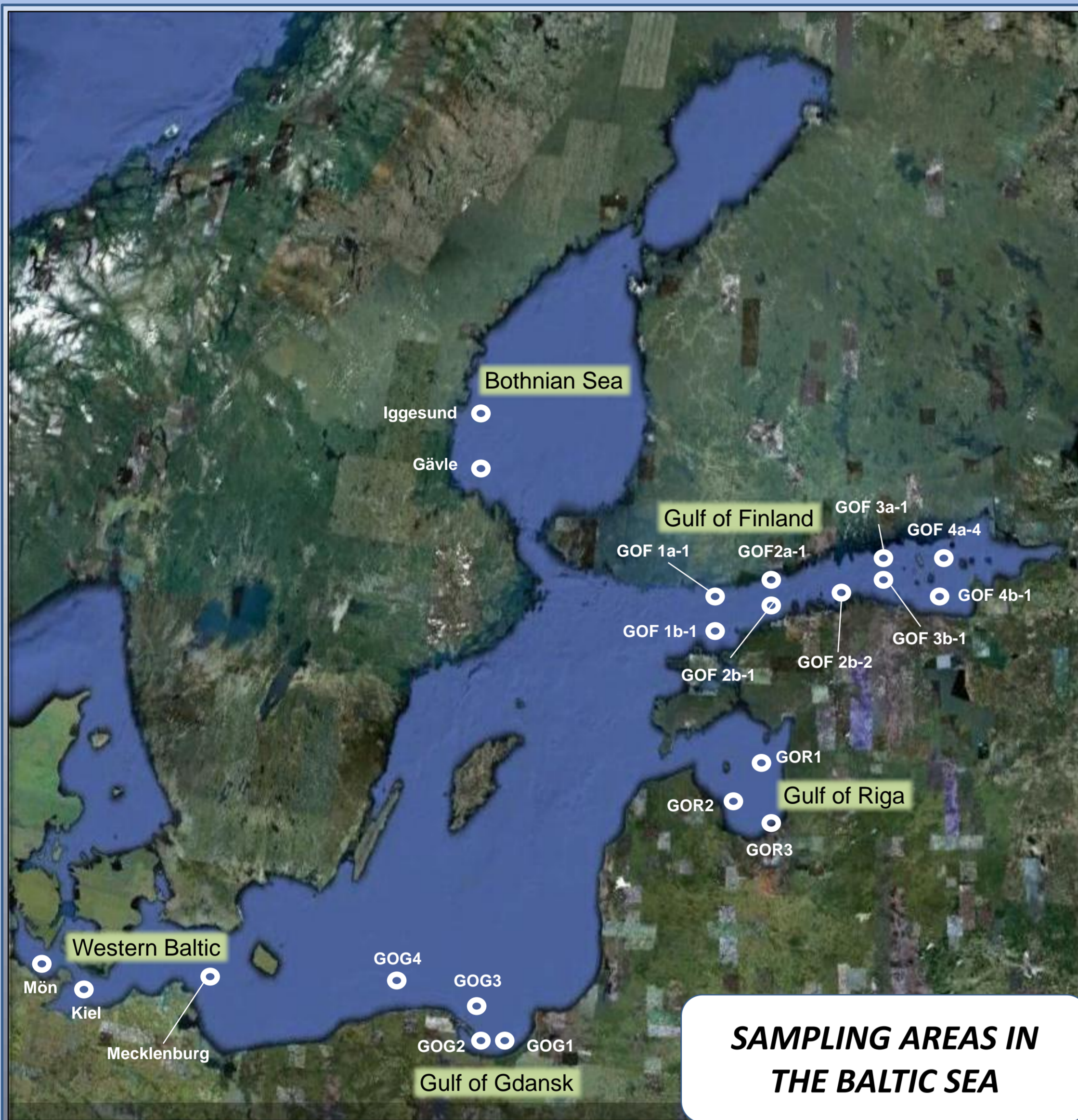
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The BEAST project ("Biological Effects of Anthropogenic Chemical Stress: Tools for the Assessment of Ecosystem Health", 2009-2011) is the most extensive international research project in the field of biological effects of pollutants carried out in the Baltic Sea region so far. As part of the sampling programme of BEAST, herring (*Clupea harengus membras*), a key species of the Baltic Sea ecosystem and one of the most important commercial species in the area, was collected during 2009 and 2010 from different sea areas (Gulf of Bothnia [Bothnian Sea], G. of Finland, G. of Riga, G. of Gdansk, and Belt Sea) for the measurement of selected biomarkers.



MATERIAL AND METHODS

- Sampling of female herring (15-25 cm in length) was carried out in Aug and Dec 2009 and Dec 2010 aboard r/v *Walther Herwing III* (Germany)
- Tissues for biomarker samples were dissected immediately on board the vessel, stored in liquid nitrogen, and analysed later in the partner laboratories using the following well-established methods:
 - **Acetylcholinesterase activity** (neurotoxicity), muscle tissue (Bocquené & Galgani 1998. ICES TIMES 22).
 - **Glutathione S-transferase activity** (Phase 2 detoxification), liver tissue (Habig et al. 1974. J Biol Chem 249:7130-7139).
 - **Catalase activity** (oxidative stress), liver tissue (Claiborne 1985. Handbook of Methods for Oxygen Radical Research, C.R.C. Press, Boca Raton, Florida, p. 283-284).
 - **Glutathione reductase activity** (oxidative stress), liver tissue (Carlberg and Mannevik 1975. J Biol Chem 250:5475-5480).
 - **Lysosomal membrane stability** (general health), liver tissue (Moore et al. 2004. ICES TIMES 36).
 - **Histopathological changes** (general health), liver tissue (Feist et al. 2004. ICES TIMES 38).
- **The Integrated Biomarker Index (IBR)** was calculated combining all single biomarker responses (Beliaeff and Burgeot 2002. Env Toxicol Chem 21, 1316-1322, modified by Broeg and Lehtonen 2006. Mar Pollut Bull 53 2006, 508-522. (NB: due to some missing data the Bothnian Sea area was left out from the IBR analysis.)

MAIN CONCLUSIONS

- Marked differences in the studied biological endpoints were recorded in herring, especially between the different sea areas of the Baltic Sea but also within them.
- Although some of the observed differences in the endpoints may partly be caused by seasonality (G. of Finland was sampled in late August, others in early December) it is likely that differences in the levels of chemical contamination in the marine environment play a key role. More data will be available at the end of 2011 for the final assessment.
- A multibiomarker approach consisting of endpoints that represent different biological levels and functions is a powerful tool to detect and assess environmental stress in marine organisms.

RESULTS

