



Leisure boat harbours, hidden alien species, and pollution: a case study of Hinsholmskilen harbour (Gothenburg, Sweden)

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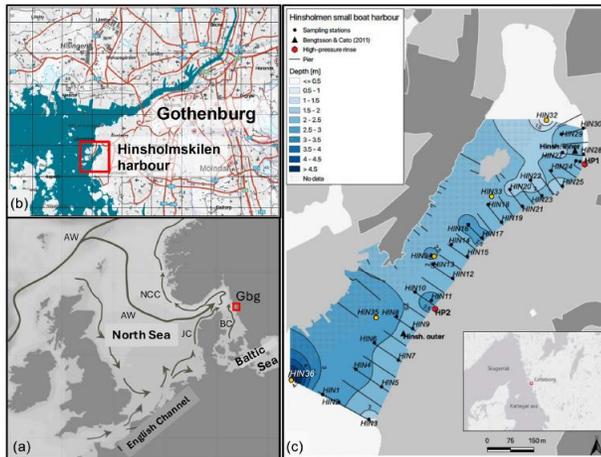


Figure 1. Map of the study area. (a) Location of Hinsholmskilen harbour in the North Sea–Baltic Sea region. The prevailing currents are indicated as follows: JC – Jutland Current; BC – Baltic Current; NCC – Norwegian Coastal Current; and AW – Atlantic Water inflow. The abbreviation Gbg stands for the city of Gothenburg. (b) Location of the study area in the city of Gothenburg (map adapted and modified from SGU, 2023) facing the Kattegat and the Gothenburg archipelago in the west. (c) Sampling locations in Hinsholmskilen harbour, for which benthic foraminifera, metal, and arsenic data were obtained in this study: manual sampling from the piers (black circles) and sampling by motorboat (orange circles). HP1 and HP2 stand for high-pressure cleaning stations, where boats are lifted and rinsed with pressurized water.

Morphological analysis (forams picking)
 Molecular identification (*T. hadai* & *A. confertitesta*)
 Metal and arsenic analyses

Redundancy analysis – scaling 2

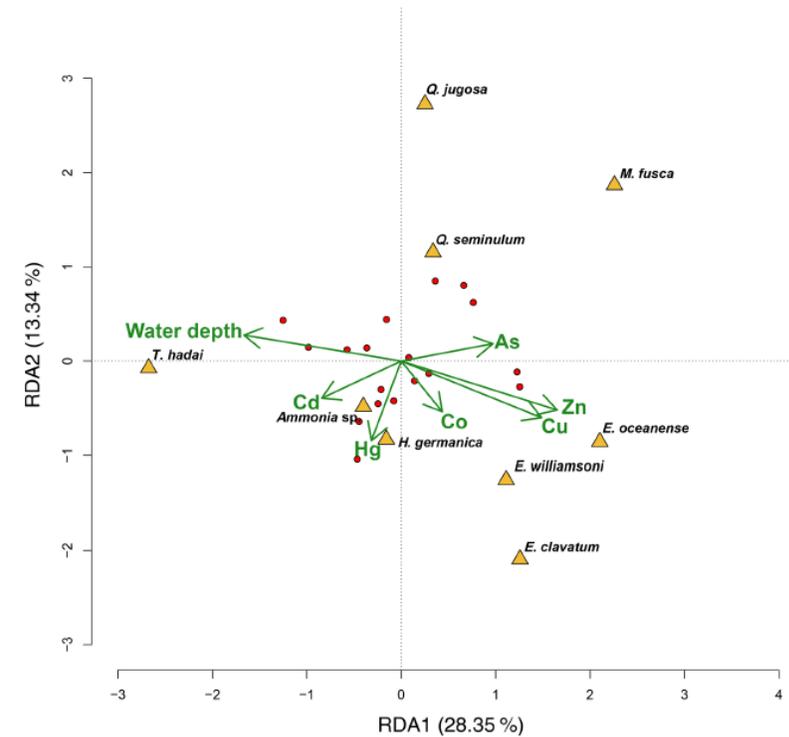


Figure 8. Redundancy analysis of foraminiferal species and environmental data from the sampling campaign in 2019. The triplot (green) shows the constraining environmental parameters, while yellow triangles and red dots represent species data and sampling sites, respectively. The first and second axes (RDA1 and RDA2) explained 28.35% and 13% of the explained variability in the species, respectively.

Conclusions:

- Typical foram estuarine community with highly abundant *Ammonia* and *Elphidium*
- Presence of 2 alien species (*T. hadai* & *A. confertitesta*)
- Good to high EcoQS for Cd, Co, Ni, Pb
- Poor to bad EcoQS for Pb, As, Zn, Cr in innermost harbour (where boats are cleaned)
- Bad EcoQS for Cu and poor EcoQS for Hg over the harbour (antifouling boat paints)