

Scientific Report of AMBER subproject WP B.6

Groundwater seepage impact on biota

Compiled by

L. Kotwicki, O. Dellwig, S. Vogler, B. Szymczycha,

J. Pempkowiak, M. E. Böttcher & T. Gentz

The major aim of subproject WP B.6 was to investigate the impact of groundwater seepage on the existing fauna (meio and macrofauna assemblages) on a seasonal scale and the effects of SGD (Submarine Groundwater Discharge) on biodiversity in coastal areas of the Baltic Sea to identify the potential threats of SGD on the biodiversity in the coastal area.

Discharge of groundwater into the sea is widespread. Submarine groundwater discharge (SGD) is one of the water pathways connecting land and ocean in the global water cycle. Moreover it has been recently recognized as important factor influencing coastal zone. In comparison with easily seen and typically large point sources surface of water inputs (e.g., rivers and streams), which are gauged and well analyzed, estimations of groundwater inputs are much more difficult due to lack of simple mean to gauge these fluxes. Groundwater in many areas has become contaminated and therefore is a source of nutrients, trace metals, organic compounds and radio nuclides. Overlooking it may lead to serious misinterpretations of ecological data in studies of coastal pollution, of benthic zonation and productivity, and of the flux of dissolved substances within and between bottom sediments and overlying water. Freshwater discharges change salinity, temperature and nutrient regimes and degrade nearshore environments.

Research area is located in the shallow area of the Puck Bay, southern Baltic Sea (Hel peninsula, north Poland, Fig.1). Field sampling was conducted between years 2009 and 2011 at Hel (6 sampling campaigns).

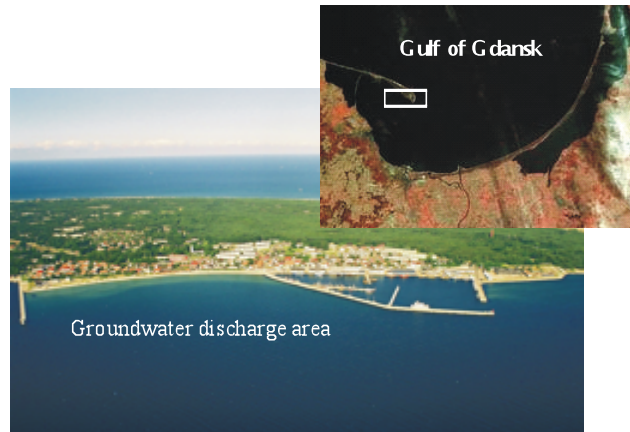


Fig. 1 Study area investigated for WP B.6 situated in the western part of Gulf of Gdańsk (outer part of the Puck Bay)

During the field campaigns in the years 2009 and 2010, it was found that low-salinity groundwater escapes at the coast line of Hel Peninsula through seeps within permeable sandy near shore sediments into the Puck Bay (Fig. 2). Salinity decreased in shallow pore waters down to 0.5 PSU along with distinctly increasing loads of metabolites.

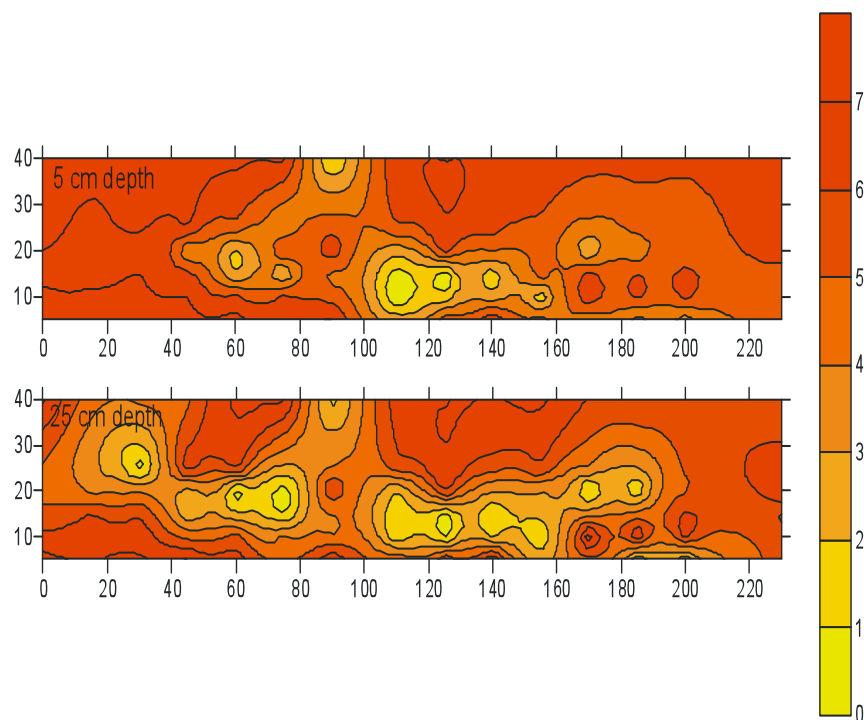


Fig. 2 Salinity of interstitial water in the sediment on 5 cm and 25 cm depth in the investigated area

This work reports the spatial effects of a groundwater discharge on the abundance and structure of the meio- and macrofauna in the shallow area of the Puck Bay (Baltic Sea). The total value of calculated direct inflow of groundwater in the investigated

area reach up to 120 m³/d and to the Baltic Sea along a Polish coast equals around 398 000 m³/d, this discharge is composed of many different chemical compounds (WP B. 4 and WP B. 5). Data are presented indicating that submarine groundwater discharge delivers, among others, several times as much nitrate. Because contaminated groundwater is often hidden, its impact on surrounding biota has not been adequately considered. Quantifying and qualifying analysis show clear effect of groundwater on both meio- and macrofauna assemblages in research area. In discharging area decreasing of abundance and number of fauna taxa in summer season and opposing pattern in winter time was observed (Fig. 3).

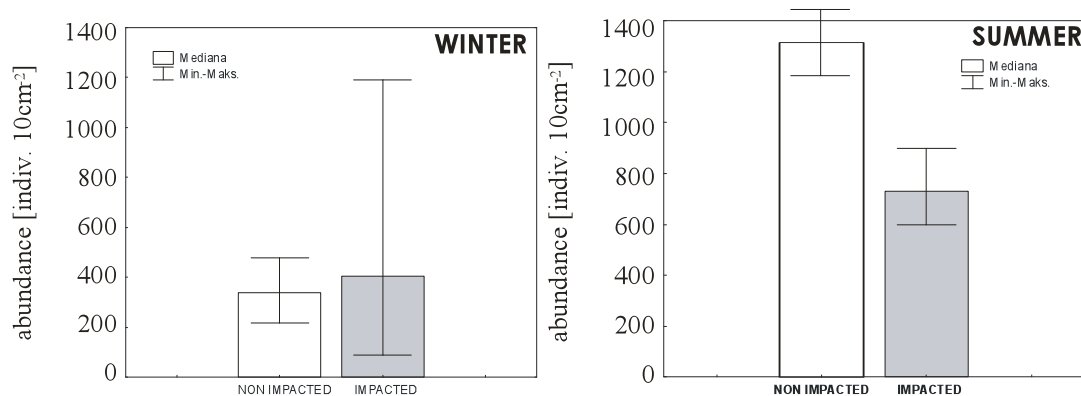


Fig. 3 Comparison of total meiofauna abundance (individuals per 10 cm²) of impacted (direct SGD seep) and non impacted areas in different seasons of the year

Groundwater discharges could significantly influence the distribution, abundance and life-history traits of the biota of shallow waters, and further study should include this phenomenon as important factors affecting spatial and temporal trends.

Results from the WP B.6 have already been presented on the BONUS conferences and several international conferences. Published manuscript: **Title: Submarine groundwater discharge (SGD) to the Baltic Sea Author(s): Pempkowiak J, Szymczycha B, Kotwicki L Source: ROCZNIK OCHRONA SRODOWISKA Volume: 12 Pages: 17-32 Published: 2010.** Two manuscripts are in preparation that will be submitted to international scientific journals in late 2011.

All meta data sets from the sampling campaigns are published on the AMBER project homepage.

References:

1. Szymczycha B., L. Kotwicki , Pempkowiak J., Submarine Groundwater Discharge to the Gulf of Gdańsk (Topic3 – 06), 6th Study Conference on BALTEX 14-18 June 2010, Międzyzdroje, Polska - poster
2. Szymczycha B., M. Miotk, L. Kotwicki, J. Pempkowiak, Mercury Concentrations In Seepage Water From The Hel District, 15th International Conference on heavy metals in the environment, 19-23 września 2010, Gdańsk, Poland -poster
3. Vogler S., O. Dellwig, P. Escher, U. Struck, S. M. Weise, B. Szymczycha, L. Kotwicki, C.-M. Mörth, T. Gentz, M. Schlüter & M. E. Böttcher A multi-isotope (C, O, S, H) and trace metal study in coastal permeable sands affected by Submarine Groundwater Discharge. Results from the BONUS+ project AMBER, European Geosciences Union General Assembly 2011