MERCURY CONCENTRATION VARIATION IN DIFFERENT FISH SPECIES OF THE GULF OF RIGA AND THE BALTIC SEA

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Introduction

Long water residence time in the Baltic sea leads to retention of hazardous substances in the ecosystem and participation of those in biogeochemical processes affecting environmental quality even after the particular source removal (The BalticSTERN, 2013). Mercury (Hg) is a heavy metal, what is widely released to the environment from natural and industrial sources (Nfon et al., 2009). Inorganic mercury is transported via atmosphere and later deposed to aquatic ecosystems, where it is converted to highly toxic and bio-accumulative organic methylmercury (MeHg) (Glasby et al., 2004). The organic Hg can be easily bio-magnificated to higher trophic levels (fish and mammals) and even transferred to human via consumption of contaminated food sources (Nfon et al., 2009; Schmitt et al., 2011). Although about the significant Hg emissions was repeatedly reported by The Baltic Marine Environment Protection Comission (HELCOM, 2007), specificity of the Baltic sea ecosystem calls for the additional research in the Hg bio-accumulation and bio-magnification patterns for every sub-region. Aim of the study was to (1) analyze concentrations of mercury in the muscle of five common fish species (cod, herring, perch, flounder and round goby) of the Gulf of Riga and the Baltic sea, and to (2) determine the concentration dependence on fish size, weight, age, species, content of lipids and sampling site.

Methods

The fish samples were collected from several background locations in the Gulf of Riga and the Baltic sea along the Latvian cost. The Hg concentrations were measured by cold vapor technique according to US EPA method 245.6 using VARIAN SpectrAA- 880 atomic absorption spectrometer (CVAAS) equipped with VGA77. Statistical analyses were performed using R software. Spearman's rank correlation coefficient (with significance level $p<0.05$) was used to measure correlations between Hg concentration and other measured variables. The numerical variables were log transformed to ensure normal distribution (Zuur et al., 2010).

Results

Fish species, size and age of individuals explained the major variation of Hg concentrations. Herring and perch species were split into gulf and sea sub-groups due to grouping in distribution of the obtained data and different Hg concentration correlation patterns with the measured variables. In contrast to other species, gulf herring had also very strong correlation of Hg levels with weight ($r=0,84$, $p<0.05$), although it was observed that gulf herring individuals with almost two times lower weight than sea herring had similar Hg concentration ranges. At the same time, gulf herring had lower lipid content than sea herring, but in case of perch the pattern was completely opposite. In addition sea perch had very strong Hg concentration correlation with age ($r=0.97$, $p<0.05$), while in the gulf the correlation was only $r=0.61$ with $p<0.05$. Among the sea sub-region species (excluding perch), the Hg concentration levels decreased as following: cod>flounder>herring>round goby.

Conclusion

The results of the study indicated notable differences of Hg concentrations between different fish species and within specific specie, depending on the individual age and the sub-region. The Gulf of Riga has higher pollution levels, where the Daugava River is significant source of mercury. It was concluded that undesirable habitat conditions (for example, marine water for perch and fresh water for herring) have notable influence on lipid content, what could be a consequence of the lack of preferable food sources. In the case, weight and length variables could give additional explanation of Hg concentration variations. It was also concluded that in general at higher trophic levels Hg concentration is higher, following the bio-magnification process, except the gulf perch, in which the Hg levels were significantly higher than in cod, what additionally supports the declaration of higher pollution levels in the gulf.

References

Glasbya, G.P.; Szefera, P.; Geldona, J.; Warzochab, J. (2004). Heavy-metal pollution of sediments from Szczecin Lagoon and the Gdansk Basin, Poland. *Sci. Total Environ*., *330(1–3)*, 249–269.

HELCOM. (2007). Heavy metal pollution to the Baltic sea in 2004. *HELCOM Balt. Sea Environ. Proc*., *No.108*.

Nfon, E.; Cousins, I.T.; Järvinen, O.; Mukherjee, A.; Verta, M.; Broman, D. (2009). Trophodynamics of mercury and other trace elements in a pelagic food chain from the Baltic Sea. *Sci. Total Environ.*, *407*, 6267–6274.

Schmitt, C.J.; Stricker, C.A.; Brumbaugh, W.G. (2011). Mercury bioaccumulation and biomagnification in Ozark stream ecosystems. *Ecotoxicol. Environ. Saf., 74(8)*, 2215-2224.

The BalticSTERN secretariat. (2013). *Background Paper: State of the Baltic Sea.* Retrieved from http://www.stockholmresilience.org/download/18.416c425f13e06f977b14a55/BalticSTERN_Stateo+of+the+Baltic+sea.pdf

Zuur, A.F.; Ieno, E.N.; Walker, N.J.; Saveliev, A.A.; Smith, G. (2010). Mixed Effects Models and Extensions in Ecology with R.; *Springer*, New York, US.