# HCH-Isomers in Baltic Herring in the Estonian Coast of the Baltic Sea (1994-2004)

Ott Roots[1], Ivan Holoubek[2], Anti Roose[3], Mart Simm[4], Anne Talvari[1]

[1]Estonian Environmental Research Centre
[2]RECETOX/TOCOEN & Associates
[3]University of Tartu
[4]Estonian Marine Institute, U. of Tartu

## Introduction

By the World Health Organization (WHO), monitoring of persistent organic pollutants in animal-derived food, especially fish, should be carried out worldwide to determine the possible sources of these contaminants in the diet. Since 1994, the analyses of hazardous substances originating from Baltic fish are a part of the Estonian National Environmental Monitoring Program. The aim of these investigations was to pinpoint the regions with higher toxicant concentrations, so that we could focus on the examination of these above-mentioned areas.

## Materials and Methods

***Materials:*** In the period 1994-2004 HCH-isomers concentrations in the Baltic Sea fish from three areas of the Estonian coastal waters were determined.

We selected baltic herring (*Clupea harengusMembras L.*), because:

- they can be caught in all parts of the Baltics (this is important for comparison )

- they are important commercial species

- their biology is fairly well known

- they are of suitable size for preanalytical sample treatment

- they are easy to collect

Fish were caught from the eastern (Kunda) and central (Tallinn) parts of the Gulf of Finland and Gulf of Riga (Liivi). The fish samples were frozen promptly following examination and selection. All organochlorine contaminants have been analyzed in the muscle tissue.

***Methods:*** The Estonian Environmental Research Centre (EERC) is accreditated by German accreditation bureau Deutshes Akkreditieruns-system Prüfwesen GmbH (DAP) ( DAP-PL-3131.00 (2008-11-22). All solvents used were of the highest quality commercially available. Ten grams of the fish sample (muscle) were homogenized in a IKA T25 homogenizer from Labassco AB, Pertille, Sweden and extracted according to Jensen et. al.[1] and the lipid content was determined by the method in Roots et. al.[2-3] Dissolved lipid (0.1-0.2 g fat) extracts were cleaned up by method – a silica gel column treated with concentrated sulphuric acid. HCH-isomers were analysed on a 90 m capillary column (DB-5) using gas-chromatography (Varian 3380) with electron capture detector (ECD).[2-4]

## Results and Discussion

On average, concentrations of γ-HCH (lindane) are higher by half than concentrations of α-HCH in the muscle tissue of Baltic herring (Table 1).

**Table 1.** Concentrations of HCH (mg/kg lipids) in the muscle tissue of Baltic herring from different parts of the Estonian coastal sea

| Marine area | Period | Number of samples | α-HCH | γ-HCH |
|---|---|---|---|---|
| Gulf of Riga (Liivi laht) | 1994 – 1995 | 7 | 0,066 ± 0,018 | 0,073 ± 0,016 |
| | 1996 – 2002* | 11 | 0,008 ± 0,002 | 0,011 ± 0,001 |
| | 2003 | 10 | 0,007 ± 0,002 | 0,023 ± 0,005 |
| | 2004 | 10 | 0,005 ± 0,000 | 0,012 ± 0,001 |
| Tallinn | 1994 – 1995 | 9 | 0,037 ± 0,011 | 0,057 ± 0,014 |
| | 1996 – 2002* | 11 | 0,008 ± 0,001 | 0,013 ± 0,002 |
| | 2003 | 10 | 0,009 ± 0,001 | 0,020 ± 0,003 |
| | 2004 | 10 | 0,005 ± 0,000 | 0,008 ± 0,001 |
| Kunda | 1994 – 1995 | 6 | 0,015 ± 0,006 | 0,068 ± 0,026 |
| | 1996 – 2002* | 8 | 0,010 ± 0,001 | 0,014 ± 0,002 |
| | 2003 | 10 | 0,009 ± 0,001 | 0,032 ± 0,004 |
| | 2004 | 10 | 0,004 ± 0,001 | 0,012 ± 0,003 |

* except 2001

Concentrations of both compounds were lower in 2004 than in 2003. Concentrations of α-HCH and γ-HCH in the muscle tissue of Baltic herring were substantially elevated in the period 1994–1995 (Fig. 1-4).

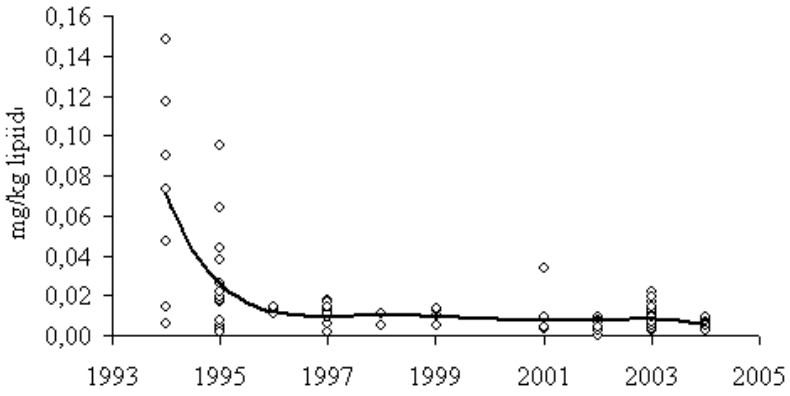


**Figure 1.** Concentrations of α-HCH in the muscle tissue of Baltic herring 1994 – 2004

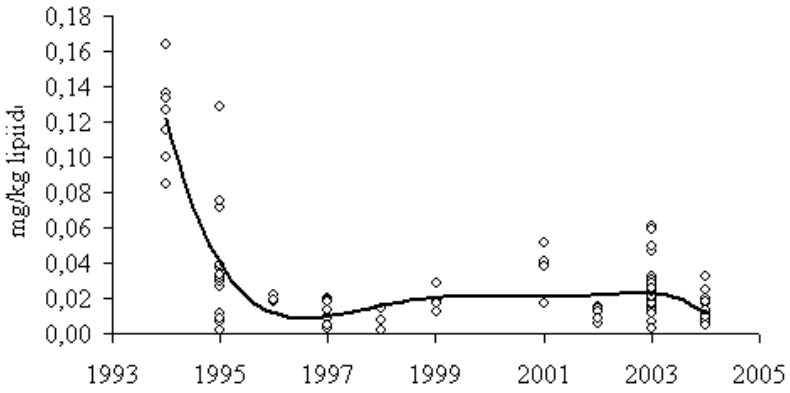


**Figure 2.** Concentrations of γ-HCH in the muscle tissue of Baltic herring (1994-2004)

To certain extent, concentrations of HCH isomers were higher than average in 2001 and 2003. Elevated concentrations in 2001 may caused by sampling the Baltic herring older than three years. Higher concentration of HCH isomers, in particular lindane, was likely influenced by increased content of these compounds in the environment. In 2004, concentrations of α-HCH and γ-HCH in the muscle tissue of Baltic herring were approximately on the same level in all sampled marine areas (Table 1). In 1994–1995, concentrations of α-HCH were the highest in the Gulf of Riga and, in contrary, the lowest in the Gulf of Finland near Kunda. Differences in toxicant concentrations in herring living in different areas of the coastal sea could also be observed (Figs. 3 and 4). Samples of other years show similar concentrations of α-HCH in the muscle tissue of Baltic herring in all coastal sea areas (Fig. 2).

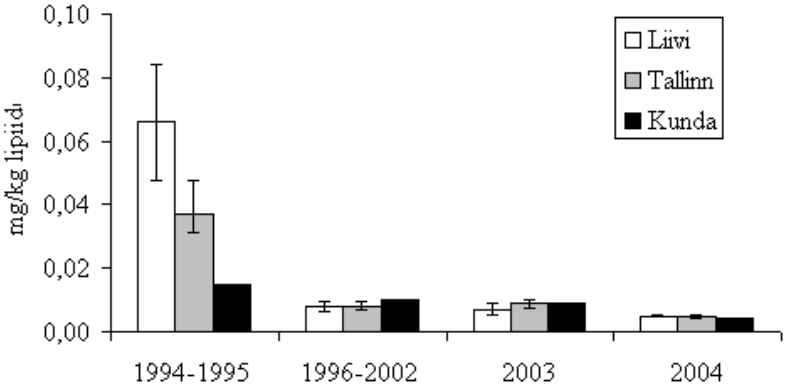


**Figure 3**. Concentrations of α-HCH in the muscle tissue of Baltic herring in various marine areas of the Estonian coastal Baltic Sea (Liivi= Gulf of Riga)

The concentration of lindane (γ-HCH) in the muscle tissue of Baltic herring is the same in all survey period in the Gulf of Riga and in the Gulf of Finland (Fig. 4).

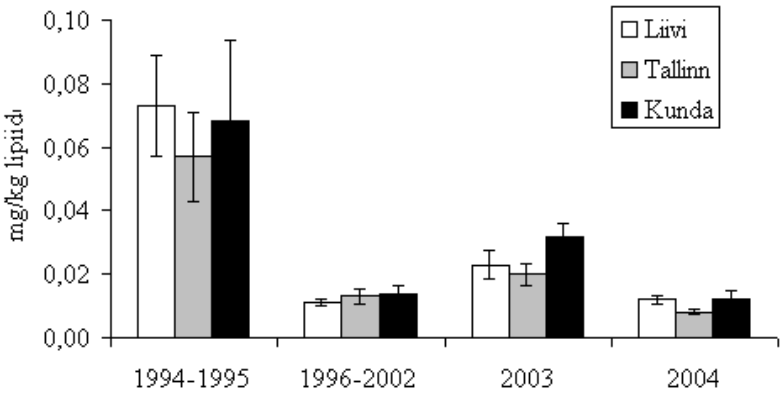


**Figure 4.** Concentrations of γ-HCH in the muscle tissue of Baltic herring in various marine areas of the Estonian coastal Baltic Sea (Liivi= Gulf of Riga)

An average concentration of α-HCH and γ-HCH varies between 0.006–0.030 and 0.008–0.034 mg/g lipids in the Baltic Sea as a whole. Ignoring data from the period 1994–1995, the concentration of lindane in the muscle tissue of Baltic herring is near upper limit only in the area of Kunda (Table 1). In summary, the concentration of HCH isomers of sampled organisms in the Baltic Sea has been decreased up to 1998, it has been proved by this survey. The concentrations of HCH stay constant since late 1990s, however elevated concentrations of lindane have been noticed in some years.

**References**

1. Jensen, S., Reuthergardh, L., and Jansson, B. (1983) *FAO Fish Tech. Paper* 212:.21-33.

2. Roots, O. (2001) *Chemosphere* 4: 623-632.

3. Roots, O., Järv, L., and Simm, M. (2004) *Estonian Coastal Sea* 13(7): 620-625.

4. Roose, A. and Roots, O. (2005) *Boreal Environment Research* 10(2): 89-102.