

ESTONIAN ENVIRONMENTAL RESEARCH CENTRE

**ENVIRONMENTAL RESEARCH**

**DETERMINATION OF DIOXINS IN THE  
FISH**

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## PREFACE

From the point of view of the health of a human the most interesting are the toxicants content in the nutrients, in the case of sea, first and foremost in the fish. It is thought that the people living near the Baltic Sea receive 80-85% of the total toxicants content namely from the fish. The high contents of chloro-organic compounds in the Baltic Sea fish is considered to one of the main reasons of the high occurrence rate of breast cancer among the women of the region and of the decreasing of the weight of the children (first and foremost boys) at birth.

The detecting of the toxicants content in fishery products is also required by the Government of the Republic regulation No. 14 from 12<sup>th</sup> January 2000 “ List of pollutants allowed in food and laying down the maximum tolerants by food groups“.

The contents of chloro-organic compounds (polychlorinated biphenyls (PCB) and chloro-organic pesticides (well-known DDT, lindane etc.)) in the biota of the Baltic Sea have been studied since the middle of the seventies. Due to the changes in analysis equipment and methods only the results gained after the nineties are comparable.

The aim of this study was to determine the contents of two compounds, which preserve in the nature, are especially toxic and accumulate in the nature - polychlorinated dibenzodioxin (PCDD) and polychlorinated dibenzofurane (PCDF) in the organisms of the fish from different areas of the Estonian economic area in the Baltic Sea. The Baltic herring was chosen as the fish under study because it is economically most important species of fish.

Because there are no facilities for analysing dioxins and furans in Estonia the analysis of the Baltic herring samples was ordered from the Institute of Ecological Chemistry of the National Research Centre for Environment and Health in Neuherberg by the Estonian Environmental Research Centre. The laboratory has been accredited in Germany for determination of dioxins and PCBs (accreditation license No. DAC-P-0141-01-00 valid through 21.11.2006).

The Baltic herring samples were collected in co-operation with the specialist of Estonian Marine Institute from four catch regions: Kunda ( kv. 77 ), Tallinn ( kv. 141 ), Gulf of Riga ( kv. 250 ) and offshore ( kv. 367 ). On the sample taking the biological parameters of the Baltic herring were also determined.

**Primary summary:** Of the eight Baltic herring samples taken from four regions of Estonian coastal waters during the spring of this year the dioxins content of them all was below the internationally permitted threshold (Base: Council Regulation (EC) No. 2375/2001 of November 2001), therefore, according to the international normatives **this Baltic herring caught from the areas of Estonian coastal waters was qualified for eating.**

**Recommendation for the fisheries:** To request the dioxins and furans analyses results of the imported fish shipments. Otherwise the fishery products shall be considered as Estonian products.

**Certainly, the analyses of the samples must be repeated in the autumn, when the fat contents of the muscles of the Baltic herring exceed the current one by 2. It would be highly suggested to analyse besides the Baltic herring, also the dioxins and furans in other exported fish, such as the sprat, perch, pikeperch etc.**

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## INTRODUCTION

The harmfulness of dioxins for the health of the people became relevant in Europe in connection with the Belgium bird scandal in 1999. The feed with the dioxin content up to 700 times higher than the maximum permitted norm, which had been sent to the farms made the consumption of poultry meat and eggs extremely dangerous. The following bans on export caused immense damages to the economy. As a result the EU regulation (Council Regulation 2375/2001) on the threshold limit value of dioxins in food, including fish was enforced in 2001. This threshold limit value in fish is 4 pgTEQ/g per wetweight. The Baltic herring and salmon have been separately brought out because in them the dioxins content presumably exceed the threshold. The rules and regulations, which took effect from July 20, 2002 in the EU member states practically forbid the use of Baltic herring and salmon for human consumption. Sweden and Finland, however have been given transitional period up to the year 2006, presuming that the population is constantly informed of the dioxins content in the Baltic fish. Also the above-mentioned countries have to annually present data on the dioxins monitoring and the measures taken to decrease the dioxin amounts, which enter into the human body.

In Estonia dioxins content in fish has not been determined. In the spring of 2002 Baltic herring samples were collected from different areas of Estonian coastal waters and they were sent to the relevant laboratory in Germany for determining the dioxins content in them. On the basis of the analyses results the dioxins content in the muscle meat of Baltic herring of different age (size, weight) will be analysed and the possible changes in different areas of Estonian coastal waters will be assessed.

## 2. MATERIAL AND METHODS

To determine the dioxins contents in the Baltic herring samples were collected from the four areas of Estonian coastal waters – Eastern and Western part of the Gulf of Finland, Gulf of Riga and offshore in March of 2002. The analysed fish were collected from industrial trawl catches. A relatively large amount– 200 g – of fish muscles was needed for the chemical analyses. Therefore each sample consists of the homogenate of back muscles cleaned of bones of tens (depending on the size 17 to 66 fish), without skins, of Baltic herring. The results of the biological analysis of the samples, the initial data have been brought in Annex 1.

In the Eastern part of the Gulf of Finland the Baltic herring was caught from the Gulf of Narva, from the Aseri-Purtse area (depth 40m). In two of the taken samples the female Baltic herring are with the average length and weight of correspondingly  $13,4 \pm 0,6$  cm and  $13,0 \pm 1,8$  g (sample K2) and  $15,0 \pm 0,8$  cm and  $17,8 \pm 2,3$  g (sample K1). Most of the fish in sample K2 were three, in sample K1 five years old. The gonads of practically all the analysed fish were in the maturity level III. The Baltic herring caught near Tallinn, West from Naissaar are characteristic to the Western part of the Gulf of Finland Soome (depth 65 – 75m). The dioxins content was separately determined in the female (sample T3) and male (sample T4) Baltic herring. The average length and weight of the female fish was correspondingly  $15,0 \pm 0,8$  cm and  $19,3 \pm 5,0$  g and most of the fish were five years old (gonads as a rule in the maturity level III). The average length of the male fish was  $14,5 \pm 1,1$  cm and weight  $17,3 \pm 4,2$  g. Most of the fish were three-four years old and their gonads were in the maturity level III – IV. In the Gulf of Riga the Baltic herring was caught near Ruhnu (depth 40 - 46m). Two years (sample L6) and four to seven years (sample L5) female Baltic herring were chosen for the samples. The average length and weight of the

younger fish was  $12,4 \pm 0,4$  cm and  $11,5 \pm 1,3$  g and of the older ones correspondingly  $16,9 \pm 0,5$  cm and  $28,5 \pm 3,0$  g. Gonads of the younger fish were in the maturity level of III – IV, in case of the older fish IV. From the offshore part of the Baltic Sea the Baltic herring was caught in the West from Hiiumaa (depth 78 – 84m). The average lengths and weights of the younger (most of them three years old, sample A7) and older (most of them seven-eight years old, sample A8) female Baltic herring were correspondingly  $13,8 \pm 0,8$  cm and  $14,9 \pm 2,6$  g and  $18,4 \pm 0,8$  cm and  $38,9 \pm 6,3$  g. In case of the younger fish the gonads were as a rule in the maturity level of III – IV, the older IV.

The determination of dioxins took place in Germany, in the Institute of Ecological Chemistry of the National Research Centre for Environment and Health in Neuherberg. The laboratory has been accredited for relative chemical detections (Deutscher Akkreditierungs Rat; DAC-P-0141-01-00; valid through 21.11.2006.a.). The method of dilution of isotopes together with HRGC/HRMS was used. The concentration of seven polychlorinated dibenzodioxins and ten polychlorinated dibenzofuranes was determined (Table 1). The limits of detection have been brought. The content of dry matter and lipids in percentages has been determined in each sample. The results of the analyses have been brought in Annex 2.

*Table 1.*

**Dioxins determined in the muscles of the Baltic herring and their toxic equivalent factors (TEF)**

No	Polychlorinated dibenzodioxins and dibenzofuranes	TEF
1	2,3,7,8-tetrachlorodibenzodioxin (TCDD)	1
2	1,2,3,7,8-pentachlorodibenzodioxin (PeCDD)	1
3	1,2,3,4,7,8-hexachlorodibenzodioxin (HxCDD)	0,1

## Dioxins content in Baltic herring in Estonian coastal waters

4	1,2,3,6,7,8-heksaklorodibensodioksiin (HxCDD)	0,1
5	1,2,3,7,8,9-hexachlorodibenzodioxin (HxCDD)	0,1
6	1,2,3,4,6,7,8-heptachlorodibenzodioxin (HpCDD)	0,01
7	Octachlorodibenzodioxin (OCDD)	0,0001
8	2,3,7,8-tetrachlorodibenzofurfane (TCDF)	0,1
9	1,2,3,7,8-pentachlorodibenzofurfane (PeCDF)	0,05
10	2,3,4,7,8-pentachlorodibenzofurfane (PeCDF)	0,5
11	1,2,3,4,7,8-hexachlorodibenzofurfane (HxCDF)	0,1
12	1,2,3,6,7,8- hexachlorodibenzofurfane (HxCDF)	0,1
13	1,2,3,7,8,9- hexachlorodibenzofurfane (HxCDF)	0,1
14	2,3,4,6,7,8- hexachlorodibenzofurfane (HxCDF)	0,1
15	1,2,3,4,6,7,8-heptachlorodibenzofurfane (HpCDF)	0,01
16	1,2,3,4,7,8,9-heptachlorodibenzofurfane (HpCDF)	0,01
17	Oktachlorodibenzofurfane (OCDF)	0,0001

## 3. DIOXINS CONTENT IN THE BALTIC HERRING

On the basis of the average concentration of the dioxins the dibenzofurfanes are predominant in the Baltic herring from the Estonian coastal waters: 2,3,4,7,8-PeCDF on the average makes up 33,4 % and 2,3,7,8-TCDF 22,1 % (Diagram 1A). Those are followed by OCDD 13,4 % and OCDF 8,6 %. On the basis of TEQ-equivalent (Diagram 1B) more than half (65,9 %) of the dioxins in the muscles of the Baltic herring is made up by 2,3,4,7,8-PeCDF, followed by 1,2,3,7,8-PeCDD (15,8 %), 2,3,7,8-TCDF (8,7 %) and 2,3,7,8-TCDD (5,0 %). The same result has been achieved during the earlier studies (HELCOM, 1990). It may be concluded that the 2,3,4,7,8-PeCDF is dominating in the muscles of the Baltic herring on the basis of both the average concentration and the toxic equivalence

The detected dioxins contents in the muscles of the Baltic herring from the Estonian coastal waters are all lower than the EU normative – 4 pgTEQ/g per wetweight (Table 2). The concentrations in the muscles of the Baltic herring collected from different areas do not differ significantly. The dioxins content in the muscles of the Baltic herring up to four years old is below 1 pgTEQ/g per wetweight, in the fish up to seven years old, as a

rule 1 – 2 pgTEQ/g per wetweight. The concentration in the oldest, seven to eight years old fish caught from the offshore is 2,6 pgTEQ/g per wet weight.

The significant, statistically reliable rise of dioxins content can be observed with the increase of the age as well as the length and weight of the fish (Diagram 2). The dioxins content in the male Baltic herring is somewhat different from the general trend, however, no theories on the occurrence of gender specificity in the accumulation of dioxins cannot be made on this single sample. Due to the fact that the lipids content in the analysed samples varied relatively little (Table 2) the connection between the dioxins concentration and fattiness of the fish cannot be established.

The detected dioxins concentrations in the Baltic herring are comparable to the results achieved during the second half of the 1990s. While according to the data of the earlier years shows that the average dioxins concentration in the Baltic herring is 8 – 10 pgTEQ/g per wet weight (HELCOM, 1990; 1993; Klinkhard, 2001), then the concentrations determined after 1995 are within the limits of 1 – 3 pgTEQ/g per wetweight (Klinkhard, 2001) and 22 – 25 pgTEQ/g per lipids' weight (HELCOM, 2002).

*Table 2*

**Dioxins contents (pgTEQ/g) in the muscles of the Baltic herring in Estonian coastal waters**

Location	Sample	Age (year)	Lipids content (%)	Per lipids weight	Per wetweight
Eastern part of the Gulf of Finland	K1	5	2,1	61,0	1,3
	K2	3	1,9	33,9	0,6
Western part of the	T3	5	1,8	91,2	1,6

## Dioxins content in Baltic herring in Estonian coastal waters

Gulf of Finland					
	T4*	3-4	2,1	90,0	1,9
Gulf of Riga	L5	4-7	2,7	64,2	1,7
	L6	2	2,0	30,9	0,6
Offshore	A7	3	1,9	44,6	0,9
	A8	7-8	2,3	115,0	2,6

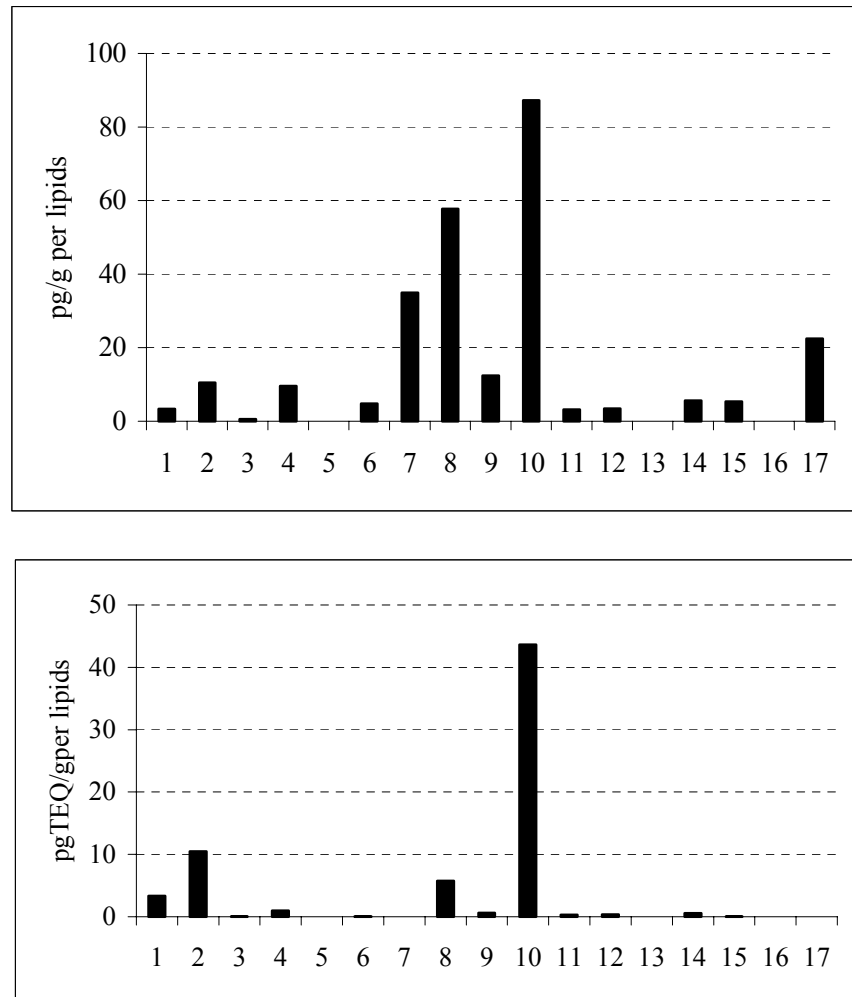
\* male Baltic herring

The disharmony of the analysed material makes it more difficult to analyse the results given for the dioxins. As a rule, it is prescribed in the monitoring programmes to determine toxicants in the two-year old female Baltic herring. However, for example in the Gulf of Finland 4-9 years old Baltic herring has been analysed during the monitoring – the dioxins content varied within the limits of 0,3 – 3,6 pgTEQ/g per wetweight (Korhonen etc., 2001). Significantly higher concentration of dioxins was detected in even older Baltic herring – 15 pgTEQ/g per wetweight in 5 – 10 years old (Korhonen etc., 2001) and 15 – 20 pgTEQ/g wetweight in 12 – 16 years old Baltic herring (Vartiainen etc., 1997). The concentration of dioxins in the muscles of the Baltic herring with the skin (Vartiainen etc., 1997) could be mentioned because it undoubtedly plays an important role in the assessment of the amount of dioxins, which enter human organism through fish products.

The fattiness of the fish plays an important role in determining the dioxins content. The lipids content in the muscles of the Baltic herring is probably lower in the spring (in our samples in average 2,1 %) than in the autumn – for example in 1997 – 1998 4,2 – 9,1% (on the other hand in the autumn of the years 1999 and 2001 only 0,4 – 3,6%). Taking the average dioxins concentration in the samples of the analysed Baltic herring – 66,4 pgTEQ/g per lipids – as a basis, we find that in the case of lipids content 4% the

dioxins concentration is on the basis of wetweight 2,7 pgTEQ/g and in case of 8% 5,3 pgTEQ/g, exceeding the already set threshold.

It may be concluded that the dioxins concentration in Baltic herring is probably lower than the content detected in the 1980s, however, depending on the fattiness of the fish it is dangerously close to the threshold limit set by the EU.



*Diagram 1. Average concentration of dioxides in the muscles of the Baltic herring*

(1 – 17 different dioxins; see number in Table 1)

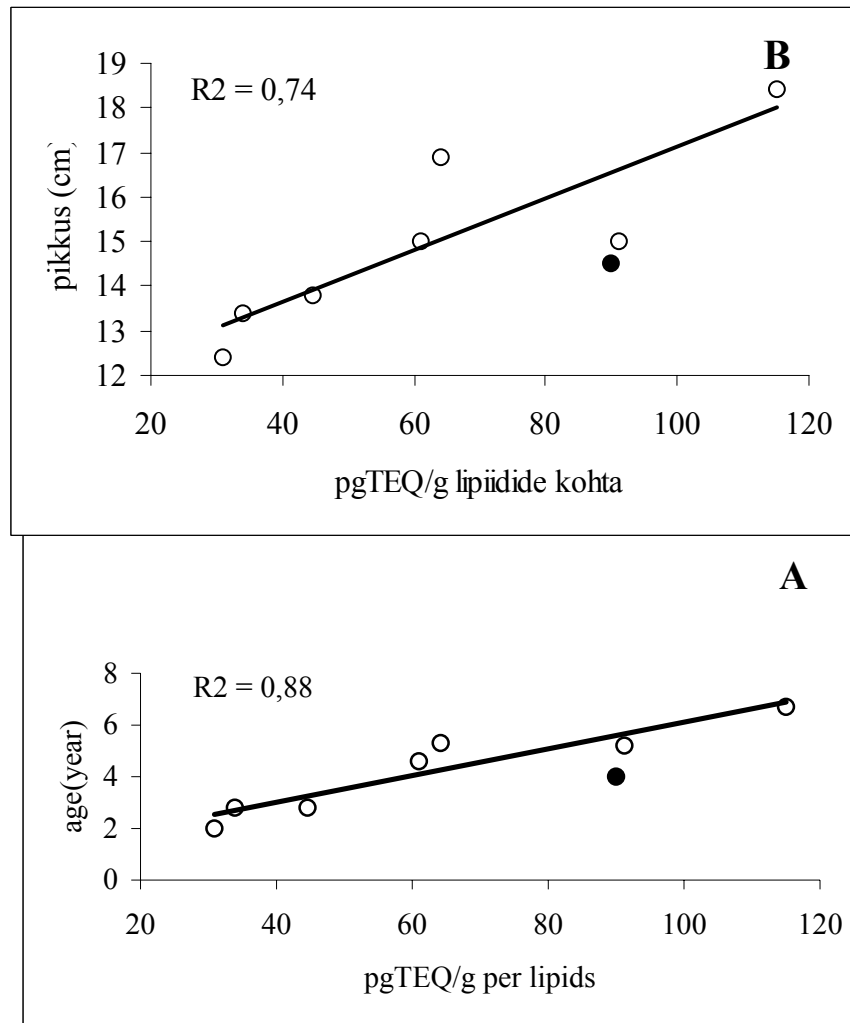
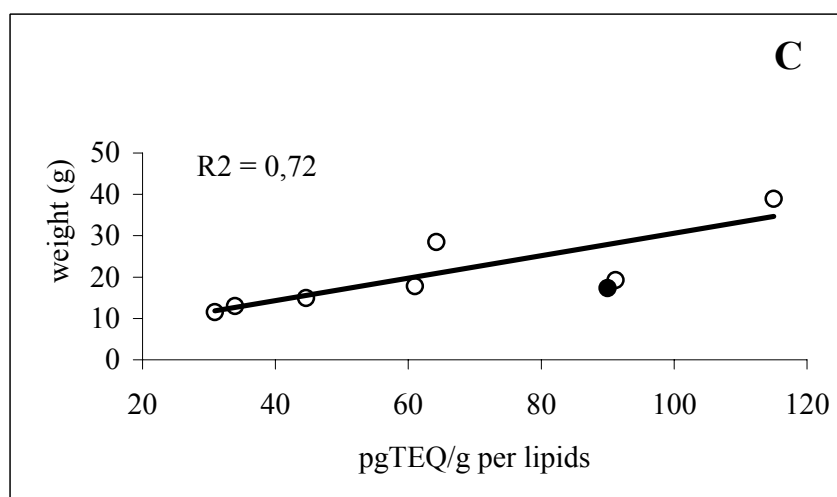


Diagram 2. Relation of dioxins concentration to the age (A), length (B) and weight (C) of the female Baltic herring. (black ring – concentration in male Baltic herring)



## SUMMARY

In the different areas of Estonian coastal waters the dioxins concentration varies in the muscles of the Baltic herring of different age (2 – 8 years) within the limits of 0,6 – 2,6 pgTEQ/g per wetweight and does not exceed the normative set by the EU – 4 pgTEQ/g per wetweight. The majority of the dioxins are made up by 2,3,4,7,8-pentachlorodibenzofurane. Dioxins concentration grows significantly with the increasing of age/measures of the Baltic herring. It may be assumed that the dioxins concentration in the Baltic herring is lower than the high contents found during the 1980s, however, depending on the fattiness of the fish it is dangerously near to the threshold set by the EU.

The achieved results do not allow giving reliable evaluation whether or not the Baltic herring is suitable for human consumption for the following reasons:

- insufficiency of material (eight samples);
- only the muscles of the Baltic herring were analysed (it is possible that the dioxins concentration in other tissues, for example in the skin is significantly higher);
- the fatness of the Baltic herring in spring is probably lower than in the autumn (the dioxins concentration depends on the amount of the lipids);
- only one of the analysed samples consisted of male fish (possible gender-specific collection of dioxins).

We must emphasise the necessity to study further the dioxins content in fish, first and foremost in the autumn Baltic herring but also in other species of fish (sprat, perch). Attention should be paid to development of the basis for relevant scientific-methodical monitoring system and finding the financial means.

## LITERATURE USED

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## ANNEX 1

The results of the biological analysis of the samples collected for determination of dioxins contents

*Annex 1, Table 1.1*

**The Baltic herring collected from the Eastern part of the Gulf of Finland (Aseri-Purtse area) on 20-21 March 2002 (sample K1)**

No.	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
1	15,9	19,7	6	3
2	14,7	17,2	5	3
3	14	14,6	4	3
4	14	14,3	4	3
5	16,3	21,7	9	3
6	15,2	19,5	5	3
7	16,8	20,6	6	3
8	15,1	15,9	4	3
9	16,1	23,4	3	3
10	15,1	19,1	3	3
11	15	18,5	4	3
12	14,4	16,8	3	3
13	14,3	15,9	3	3
14	15,1	19,4	5	3
15	14	16,4	2	3
16	14,4	15,1	4	3
17	15	16,6	5	3
18	14,7	18,4	4	2
19	13,9	15,2	3	3
20	14,6	16,3	4	3
21	14,9	17,6	8	3
22	14,5	17,6	3	3
23	14,1	16,6	3	3
25	16,3	21,8	9	3
26	14,4	15,9	4	2
27	15,5	21,2	6	3
28	15,9	17,7	4	3
29	14,1	16,5	3	3
30	15,4	16,5	6	3
31	14,6	17,4	4	3
32	15,8	19,5	6	3

**The Baltic herring collected from the Eastern part of the Gulf of Finland (Aseri-Purtse area) on 20-21 March 2002 (sample K2)**

No	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1	13,4	12	3	3
2	13,9	13,8	4	3
3	13,7	12,6	3	3
4	12,8	10,3	3	3
5	13,9	15	2	3
6	13,6	13,9	4	3
7	13,1	13	2	3
8	13,3	13,7	2	3
9	12,5	11	3	3
10	14,2	15,5	5	3
11	13,9	12,8	3	3
12	13,6	14	2	3
13	13,2	11,5	3	3
14	11,9	8,3	2	3
15	13,5	12,9	2	3
16	14	14,2	3	3
17	13,9	12,2	6	3
18	13,8	12,3	4	3
19	13,4	12,3	2	3
20	13,2	12,3	2	3
21	12,9	14	3	3
22	13,4	12,6	2	3
23	13,9	14,4	2	2-3
24	12,9	11,9	2	2(6)
25	13,3	12,6	2	3
27	13,1	12,9	2	3
28	13,5	14,8	2	3
29	13,9	15,4	3	3
30	12,7	11,9	3	3
31	13,8	14,9	3	3
32	13,1	12,8	2	3
33	13,6	13,7	3	3
34	13,2	13,1	3	3
35	13,6	12,9	3	3
36	13,7	13,6	3	3
37	13,1	12,1	3	3
38	12,4	11,5	2	3
39	14	14,2	3	3
40	13,5	13,7	3	3
41	13,2	11,1	3	3
42	12,8	10,5	3	3
43	14,2	16,3	3	3
44	12,2	10	3	3

## Dioxins content in Baltic herring in Estonian coastal waters

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45	12,9	11,2	2	3
46	12,5	11	4	3
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
47	14	15,3	3	3
48	14,4	14,6	3	3
49	13,2	12,2	3	3
50	12,9	11,5	3	3
51	12,1	8,3	2	3
52	12,4	10	3	3
53	14,1	14,2	4	3
54	13,5	13,6	3	3
55	12,3	9,9	3	3
56	14,1	14,2	3	3
57	14,2	15	3	3
58	13,1	12,3	2	3
59	13,2	12,8	2	3
60	14,3	16,3	3	3
61	13,6	14,3	2	3
62	14,3	15,2	4	3
63	13,8	14,8	3	3
64	13,5	12,8	3	3
65	14,1	14,5	3	3
66	13,9	14,1	3	3

**The Baltic herring collected from the Western part of the Gulf of Finland (Tallinn area) on 12<sup>th</sup> March 2002 (sample T3)**

No.	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
1	16,7	29	8	4
2	15	17,3	4	3
3	17	32,2	5	4
4	14,5	19,1	5	3-4
5	15,6	23	5	3-4
6	16,1	24,7	10	3-4
7	14,6	16,9	5	3
8	14,1	17	3	4
9	16,1	29,3	6	4
10	16	23	8	3
11	15	19,8	5	3
12	14,9	15,8	5	2-3
13	15	15,7	5	3
14	14,5	17	5	3
15	15,1	17,4	5	3
16	14	14,7	4	3
17	14,8	16,5	5	3
18	15,1	18,3	5	3
19	14,5	17,2	5	3
20	14	16,7	5	3-4
21	13,9	13,2	4	3
22	15,6	18,8	5	3
23	14,6	15,5	5	3
24	14,5	16,2	5	3

**The Baltic herring collected from the Western part of the Gulf of Finland (Tallinn area) on 12<sup>th</sup> March 2002  
(sample T4; male fish)**

No.	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
1	16,1	17,9	5	3
2	16	26,5	4	4
3	15,4	15,3	9	3
4	13,2	14,1	3	4
5	13,4	14,7	3	4
6	15,8	25,4	6	4
7	13,6	17,6	3	4
8	14,2	16,9	4	4
9	17,4	26,3	5	3
10	13,6	15,2	3	3
11	14,3	16,4	4	2(6)
12	16,1	25,2	5	4
13	13,4	11,9	3	4
14	13,9	15,1	3	2(6)
15	15,4	17,9	4	4
16	14,1	14,8	3	2(6)
17	14,1	16,7	4	3
18	14,1	15,3	3	3
19	13,6	13,7	3	3
20	15	18,2	4	4
21	13,9	15,7	4	3
22	14,1	15,4	3	2(6)
23	13,6	13	3	4
24	14,7	15,2	3	4

**The Baltic herring collected from the Gulf of Riga (Ruhnu area) on 28<sup>th</sup> March 2002****(sample L5)**

No.	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
1	16,9	27,3	7	4
2	16,8	29,4	5	4
3	16,8	27,7	4	4
4	16,7	28,6	4	4
5	16,6	24,3	4	3
6	16,4	26,5	4	4
7	17,5	29,9	5	4
8	16,1	23,4	4	3-4
9	16,2	24,7	3	4
10	16,2	24,6	6	4
11	16,9	25,7	5	3-4
13	17,1	29,4	7	4
14	16,9	29,6	7	4
15	16,6	29,9	5	4
16	16,6	28,7	7	4
17	16,9	26,7	7	4
18	17,6	37,1	5	4
19	17,1	28,5	4	4
20	17,1	32,8	7	4
21	16,6	27,4	4	4
22	16,8	29,2	4	4
23	17,4	31,4	6	4
24	17,6	27,2	6	4
25	16,5	26,4	7	4
26	18,1	33,4	5	4
27	16,5	28,7	3	4
28	16,1	28,3	6	4
29	17,1	28,6	6	4
31	16,7	27,4	5	4
32	17,6	33,6	7	4
33	16,6	26,4	6	4

**The Baltic herring collected from the Gulf of Riga (Ruhnu area) on 28<sup>th</sup> March 2002****(sample L6)**

No.	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1	12	11,3	2	3
2	12,6	13,3	2	4
3	12,5	12,6	2	3-4
4	13	14,5	2	3
5	12,7	12,9	2	4
6	12,9	13,4	2	3
7	12,6	12,7	2	3-4
8	12,5	11,6	2	3-4
9	12,2	11,7	2	4
10	12,4	11,2	2	3-4
11	13	14,2	2	4
12	13,1	13,3	2	4
13	12,4	11,4	2	4
14	12,4	11,3	2	4
15	12,6	11	2	3
16	12,4	10,9	2	3
17	12,3	10,2	2	4
18	12,6	11,9	2	3-4
19	11,6	9,8	2	4
20	12,6	11,6	2	3-4
21	12,2	12	2	4
22	12,9	12,7	2	2-3
23	13	13,5	2	4
24	11,6	9	2	2-3
25	12,2	10,4	2	3
26	11,3	9,5	2	3
27	11,7	10,4	2	4
28	12,6	10,4	2	3
29	11,6	10,3	2	4
30	12,4	12,1	2	4
31	12,4	12,4	2	4
32	12,3	11,8	2	4
33	12,4	12,4	2	4
34	12	10,1	2	3
35	12,6	11,1	2	3
36	12,3	10,2	2	2-3
37	12,6	11,7	2	3
38	13,4	11,8	3	3
39	12,9	12,1	2	4
40	12,4	10,4	2	3-4
41	12,8	11,5	2	2-3
42	13,1	13	2	4
43	12,4	12	2	2-3

## Dioxins content in Baltic herring in Estonian coastal waters

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44	12,3	10,9	2	2-3
45	12,5	10,8	2	4
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
46	11,7	8,8	2	3
47	12,5	11,7	2	3
48	12,4	11,6	2	3
49	11,8	9,4	2	3
50	12,5	11,3	2	4
51	12,3	11,5	2	4
52	12,1	9,6	2	3
53	12,3	10,3	2	3
54	12,6	12,6	2	3-4
55	11,8	10,7	2	4
56	12,5	13	2	4
57	12,4	10,2	2	3
58	12,2	11,8	2	3
59	12,2	10,6	2	2-3

**The Baltic herring collected from the offshore (West from Hiiumaa) on 27<sup>th</sup> March****2002****(sample A7)**

No.	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
1	12,4	10,4	2	3-4
2	12,2	11,5	2	4
3	11,9	9,8	2	3-4
4	14,8	20,6	3	4
5	14,9	16,6	3	2
6	12,8	11,3	2	3
7	13,9	16,7	3	4
8	14	16,7	3	4
9	12,9	11,9	3	3-4
10	12,3	11,6	2	4
11	14,2	16,5	3	3-4
12	14	17,2	4	4
13	14	14,6	2	3
14	13,1	11,4	2	3
15	13,4	13,6	2	3-4
16	13,5	14,6	3	4
17	13,9	15,5	3	3-4
18	14,7	18,9	4	4
19	14,9	17,9	2	3
20	12,6	9,6	2	3
21	13,3	13,2	2	3
22	14,3	15,9	3	4
23	12,8	12	2	3
24	13,5	13,6	3	3
25	13,7	14,9	3	3-4
26	13,9	13,7	3	3
27	13,1	13,5	2	3-4
28	13,3	14,3	3	4
29	14,1	15,1	3	3
30	13,5	12,6	3	2
31	13,3	14,3	2	3-4
32	14,3	15,7	3	3-4
33	12,9	12,9	2	4
34	14,3	14,7	3	2-3
35	13,9	13,9	3	3
36	14,3	17,2	3	3-4
37	14,1	15,2	2	3-4
38	14,4	15,9	3	4
39	15,2	21,3	3	3-4
40	14,7	20,4	5	4
41	13,8	16,1	3	4
42	14,4	15,9	3	3

## Dioxins content in Baltic herring in Estonian coastal waters

43	14,3	17,7	3	3-4
44	14,8	15,7	3	3
45	14,6	12,7	5	3
46	14,2	15,7	3	3
47	14,1	15,2	3	3-4
48	14,2	15,9	3	4
49	14,1	15,9	2	3

*Annex 1, Table 1.8*

**The Baltic herring collected from the offshore (West from Hiiumaa) on 27<sup>th</sup> March**

**2002**

**(sample A8)**

No.	Length (cm)	Weight (g)	Age (year)	Maturity level of the gonads
1	19,2	49,2	6	4
2	18,4	42,7	8	4
3	18,3	33,3	8	4
4	18,6	39,8	3	4
5	18,9	44	8	4
6	18,1	33,8	5	4
7	18,3	36,8	8	4
8	20,3	51,2	9	4
9	18,1	34,5	6	3
10	19,8	50,1	7	4
11	18,1	38,6	7	4
12	18	32,4	3	3-4
13	17,8	36,4	7	4
14	18,1	37,4	8	4
15	17,4	32,2	5	4
16	18	34,8	9	4
17	17,7	34,6	7	4