Institut für Vogelforschung "Vogelwarte Helgoland", An der Vogelwarte 21 D-26386, Wilhelmshaven

Documentation of the TMAP Parameter "Pollutants in seabird eggs" in The Netherlands in 2007

1. Egg sampling

1.1 Sampling sites in the Wadden Sea in 2007

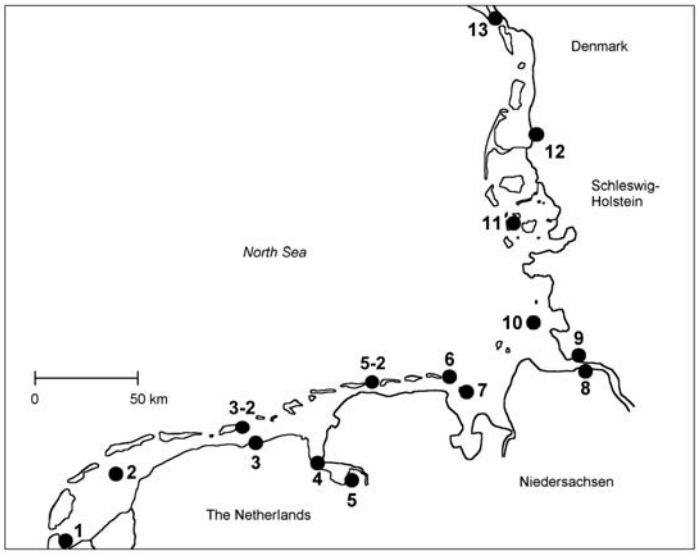

Fig. 1: TMAP parameter „Contaminants in bird eggs": Sampling sites of Oystercatcher and/or Common Tern eggs in the trilateral Wadden Sea. The Netherlands: 1 Balgzand, 2 Griend, 3 Julianapolder, 3-2 Schiermonnikoog, 4 Delfzijl; Germany, Lower Saxon: 5 Dollart, 5-2 Baltrum, 6 Minsener Oog, 7 Mellum (6 and 7 = Jade), 8 Hullen, 9 Neufelderkoog (8 and 9 = Elbe estuary); Germany, Schleswig Holstein: 10 Trischen, 11 Norderoog/Hallig Hooge; Denmark: 12 Margrethekoog, 13 Langli. At sites 3, 5, 7, 8 and 13 only Oystercatcher eggs, at sites 3-2, 6 and 9 only Common Tern eggs have been taken.

1.2 The following egg samples were collected in The Netherlands in 2007:

	Species	
Site	Oystercatcher	Common Tern
Balgzand	10	10
Griend	10	10
Julianapolder	10	-
Schiermonnikoog		-
Delfzijl	10	10

2. Chemical analytics

The samples were analyzed as shortly described by Sommer et al. (1997) and Becker et al. (2001). You can get a detailed description of methods on request.

3. Documentation of data, description of the EXCEL-file and of the variables

The data from The Netherlands in 2007 are documented in an EXCEL-file (already sent on disk). The variables in the EXCEL-file are explained in the file-head.

4. Assessment of the results

To present a short assessment of the data, we prepared and present statistics for the following most important chemicals or chemical groups:

ORGANOCHLORINES:

ΣHCH	α-HCH β-HCH γ-HCH
ΣDDT	p,p'-DDE p,p'-DDT p,p'-DDD
ΣPCBSUM	62 congeners
Σ6PCB	6 PCB-congeners (PCB28, PCB52, PCB101, PCB138, PCB153, PCB180)
HCB	
ΣChlordane	Sum of Chlordan and Nonachlor-compounds: TCHLORDA (trans-Chlordan) CCHLORDA (cis-Chlordan) TNONACHL (trans-Nonachlor) CNONACHL (cis-Nonachlor)

HEAVY METALS:

Hg (mercury)

All concentrations are given in ng $\cdot g^{-1}$ fresh weight of the eggs.

Statistics:

For analysing temporal trends Spearman rank correlations were calculated (two-tailed) for the years 2003 - 2007. In the figures, arithmetic means ± 95% confidence intervals are presented. If the confidence intervals do not overlap, significance of at least $p < 0.05$ is indicated.

5 Results

5.1 Annual variation

Balgzand 2003 - 2007

In 2007, significantly lower mercury- and Chlordane-levels in Common Tern eggs than in 2006 were found.

Temporal Trends (see Enclosures):

Oystercatcher	Significant **increases** were detected in HCB and HCH, **decreases** in DDT and Chlordanes.
Common Tern	Significant **increases** were detected in HCH, **decreases** in Chlordanes.

Griend 2003 - 2007

In 2007, in Oystercatcher eggs significantly higher Chlordane-levels were found than in 2006. Significantly lower Hg-levels and higher HCH-levels were found in Common Tern eggs.

Temporal Trends:
In both species, the negative trend in DDT during the last years was continued (n.s.).

Oystercatcher	Significant **increases** were detected in mercury, HCB and HCH, **decreases** in PCB and Chlordanes.
Common Tern	Significant **increases** were detected in mercury and HCH, **decreases** in Chlordanes.

Julianapolder/Schiermonnikoog 2003 - 2007

In 2007, significantly higher mercury-levels were found in Oystercatcher eggs than in 2006.

Temporal Trends:

Oystercatcher	Significant **decreases** in the concentrations of PCB, DDT and Chlordane were identified.

Delfzijl 2003 - 2007

In 2007, significantly lower HCB- and Chlordane-levels in Oystercatcher eggs were found than in 2006. Significantly higher HCH-levels were found in Common Tern eggs.

Temporal Trends:

Oystercatcher	Significant **decreases** were detected in mercury and Chlordanes.
Common Tern	Chlordane **decreased** significantly.

Since 2004 in both species an increase in HCH is evident (n.s. in the 5y perspective).

5.2. Spatial trends of selected contaminants in the Wadden Sea in 2007

In 2007, at all of the 13 for the TMAP parameter „Contaminants in bird eggs" selected sites, apart from Schiermonnikoog and Margrethekoog, eggs could be sampled and analysed (Fig. 1).

For the Oystercatcher, we identified areas with relative high contaminations:

Mercury:	Hallig Hooge, Trischen, Hullen (Elbe), Baltrum, Griend, Balgzand
PCB:	Dollart, Delfzijl, Julianapolder
HCB:	Hullen (Elbe), Dollart, Delfzijl
DDT:	Hullen (Elbe), Trischen
HCH:	Trischen, Griend, Hullen (Elbe)

For Common Tern the intersite variation was more distinct than for Oystercatcher. In the following areas relative high contaminations of Common Tern eggs were detected:

Mercury:	Neufelderkoog (Elbe)
PCB:	Neufelderkoog (Elbe), Balgzand, Griend, Delfzijl
HCB:	Neufelderkoog (Elbe)
DDT:	Neufelderkoog (Elbe)
HCH:	Neufelderkoog (Elbe)
Chlordan:	Griend

Geographic variation in the concentrations of the pollutants again demonstrates the importance of the river Elbe regarding the input of chemicals into the North Sea. The geographic pattern is similar to that of the recent year. In general, the concentrations of the pollutants in the different areas decreased with increasing distance to the Elbe estuary, with the exception of Chlordane.

A further contamination hot spot is the western part of the Wadden Sea. This is indicated by elevated mercury-concentrations in Oystercatcher eggs, being still much lower than those detected at the Elbe, however.

As in last years survey, the concentrations of Griend and Balgzand are considerably higher compared to those from Julianapolder, Delfzijl und Dollart. The pattern for PCB, HCB- and DDT is the other way around: Concentrations of these pollutants are lower at Griend and Balgzand, but elevated at Delfzijl und Julianapolder.

Compared to the Oystercatcher this trend is less distinctive in Common Tern eggs. Only PCB is still elevated at Balgzand, Griend and Delfzijl.

At the Ems, elevated PCB-, HCB- and DDT concentrations were detected, with PCB levels exceeding those found at the Elbe. Elevated HCB-concentrations from 2004 – 2006 in the Oystercatcher eggs collected at Delfzijl had strongly decreased in 2007.

Common Tern eggs from the Elbe again showed highest mercury-, PCB-, HCB-, DDT- and HCH-concentrations, compared to all other areas. But the exceptional high HCH-concentrations, found in 2006, decreased in 2007.

6. General Assessment

Results of 2007 show higher concentrations of most chemicals investigated in birds breeding at the Elbe estuary or on Trischen compared with birds breeding in the northern or western parts of the Wadden Sea. Again it is shown that the contamination of the sampled eggs decrease continuously from the Elbe estuary in northern and western direction.

High concentrations of mercury in Oystercatcher eggs from the western part of the Wadden Sea indicate higher contamination in the area of Balgzand and Griend, whereas PCB and DDT contaminations were higher in the area Dollart and Delfzijl. Mercury-, PCB- and DDT-concentrations which had decreased during the last years remained on the level of 2006. Over the past five years, Chlordan-concentrations decreased in all areas, with the exception of the Dollart.

The decreasing level of contamination is most obvious in the eggs of the Common Tern, sampled at the Jade, where mercury-, PCB-, HCB-, DDT- and Chlordan-concentrations decreased.

Also at the Elbe declining concentrations of pollutants were detected in eggs of the Oystercatcher. Over the past five years, DDT-, HCH- and Chlordan-concentrations had decreased significantly. This is interpreted as a reduced input of pollutants via the Elbe from 2004 to 2007.

This trend seems to have continued in 2007. There is not a single case of increasing contaminant concentrations at the Elbe. At Trischen the concentration of many contaminants, too, decreased significantly compared to 2006, but also over the past five years. The same is true for Hallig Hooge: the elevated HCH-concentrations of the past years decreased for both analysed species, just as at Trischen. Also at Langli a distinct decrease in contaminant concentrations of both species was detected.

In 2007 in the western part of the Wadden Sea mainly stable contaminant concentrations were found, compared with 2006, but in a few cases concentrations decreased. In general concentrations are in 2007 at the same level as those before 2004, where elevated levels of some chemicals where found in the eggs. For mercury in Common Tern eggs significantly reduced levels were detected at Balgzand and Griend.

Fortunately this seems to be a continuous trend for the majority of the analysed chemicals, leading to a negative time trend (2003-2007) in 38 cases, whereas only 13 cases showed a positive trend.

For the time interval 2003-2007 among the analysed chemicals there are 13 significant cases of increasing concentrations in eggs of seabirds: M**ercury** (Oystercatcher: Griend, Norderoog/Hallig Hooge; Common Tern: Griend (due to the high concentrations in 2005 and 2006)), **HCB** (Oystercatcher: Balgzand, Griend (due to the increase in 2004), Jade; Common Tern: Elbe), **DDT** (Common Tern: Elbe), **HCH** (Oystercatcher: Balgzand, Griend (due to the increase 2004), Dollart (due to the increase 2005 and 2006); Common Tern: Balgzand, Griend).

In conclusion this recent report makes obvious, how quick changes in the contamination of the environment can be detected in the eggs of seabirds. Even many years after the ban of certain chemicals, input and mobilisation may still occur. This demonstrates the necessity of continuous controls and probably additional measures, in order to control and reduce the anthropogenic input of contaminants into the North Sea.

7. Literature

Becker, P.H., & J. Muñoz Cifuentes (2004): Contaminants in birds eggs: recent spatial and temporal trends. In: Wadden Sea Ecosystem No. 18, 5-25. Common Wadden Sea Secretariat, Wilhelmshaven.

Becker, P.H., J. Muñoz Cifuentes (2005): Contaminants in Birds Eggs. Chapter 4.5. In: Essink,K., Dettmann,C., Farke, H., Laursen, K., Lüerßen, G., Marencic, H., Wiersinga, W. (Eds.) Wadden Sea Quality Status Report 2004. Wadden Sea Ecosystem No. 19. Trilateral Monitoring and Assessment Group, Common Wadden Sea Secretariat, Wilhelmshaven, Germany: 123-128.

Becker, P.H., J. Muñoz Cifuentes, B. Behrends & K.R. Schmieder (2001): Contaminants in Bird Eggs in the Wadden Sea – Spatial and Temporal Trends 1991 – 2000. Wadden Sea Ecosystem 11. Common Wadden Sea Secretariat Wilhelmshaven: 68 pp.

Becker, P.H., S. Schuhmann & C. Koepff (1993): Hatching failure in Common Terns (*Sterna hirundo*) in relation to environmental chemicals. Environ. Pollut. 79: 207-213.

Muñoz Cifuentes, J. (2004): Seabirds at risk? Effects of environmental chemicals on reproductive success and mass growth of seabirds breeding at the Wadden Sea in the mid 1990s. Wadden Sea Ecosystem No. 18.

Sommer, U., K.R. Schmieder & P.H. Becker (1997): Untersuchung von Seevogeleiern auf chlorierte Pestizide, PCB's und Quecksilber. BIOforum 20 (3/97): 68-72.

8. Enclosures

8.1 Table of chemical concentrations in eggs of Oystercatchers and Common Terns in The Netherlands in 2007
8.2 Spatial trends of selected contaminants in the trilateral Wadden Sea 2007 in Oystercatcher and Common Tern eggs
8.3 Temporal trends at each site, 2003 – 2007

9. This report was compiled by Peter H. Becker, Silke Kahle and Ursula Pijanowska.

Wilhelmshaven, 22 January 2008

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(Prof. Dr. Peter H. Becker)

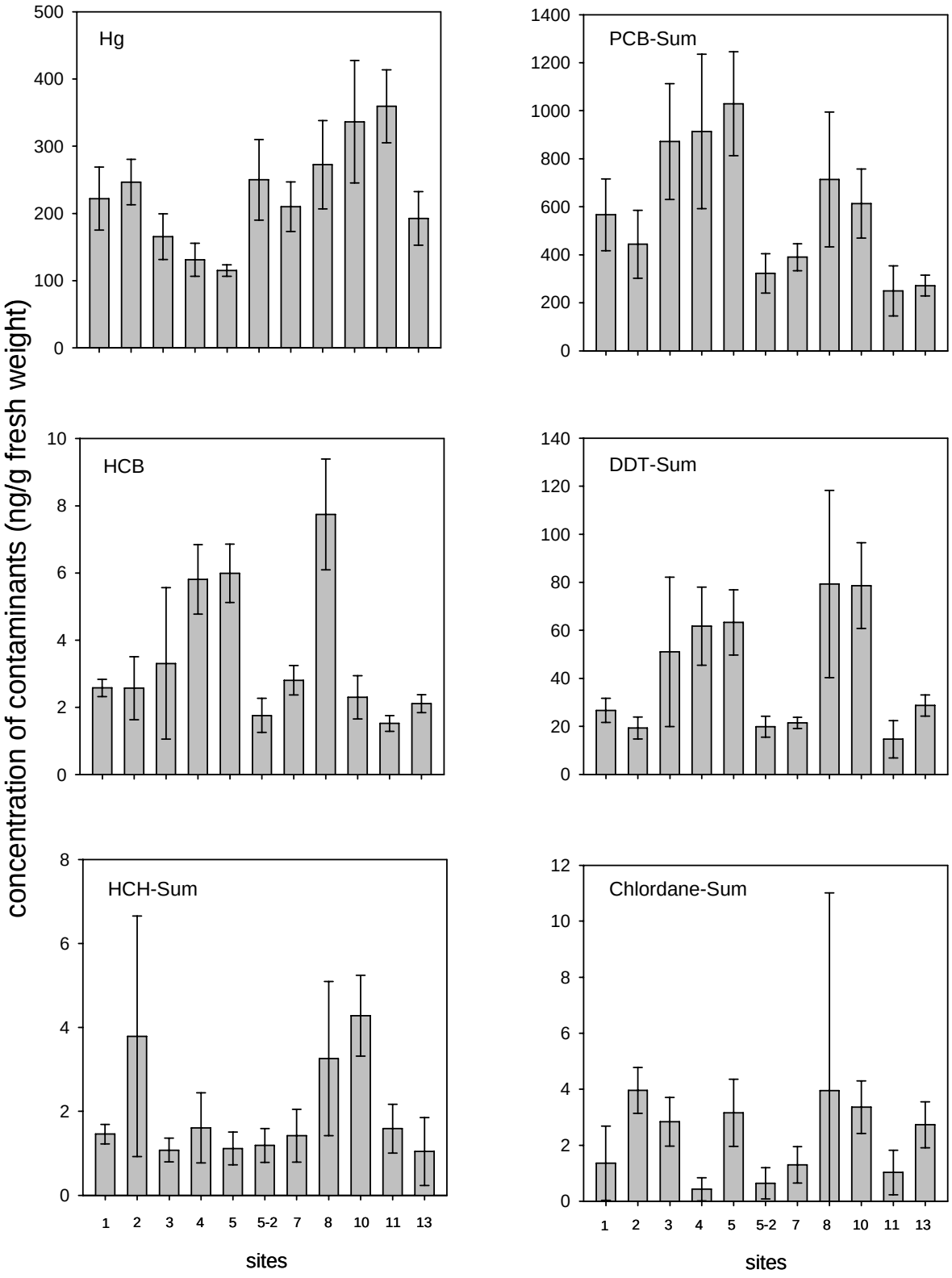
8.1 Contaminants in bird eggs 2007 in The Netherlands

Table 1: Concentrations of chemicals in Oystercatcher and Common Tern eggs sampled in The Netherlands in 2007.
Mean concentrations in ng · g $^{-1}$ (fresh mass of egg content), standard deviations and number of samples are presented.

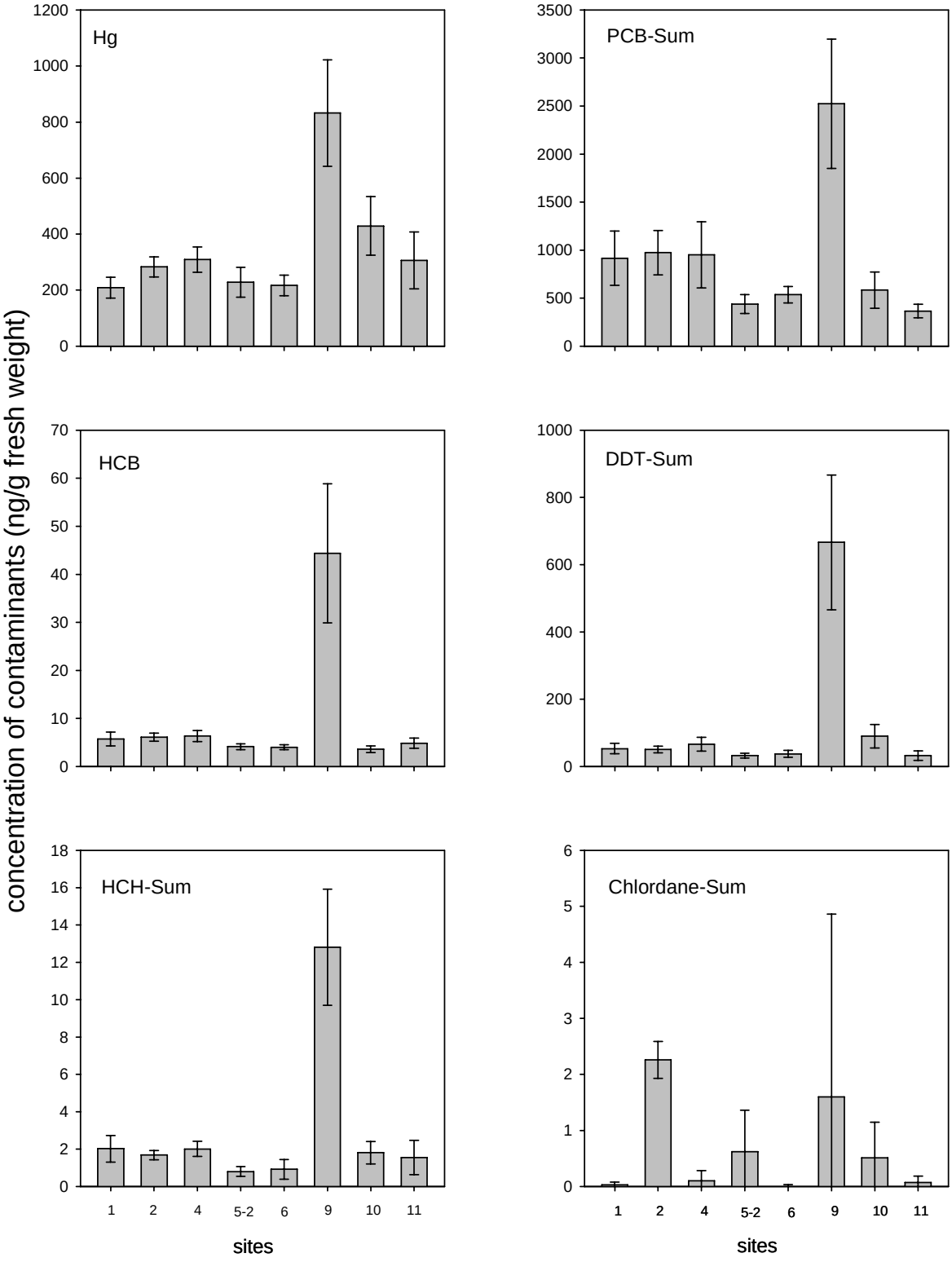
Oystercatcher	**Balgzand** (N=10)			**Griend** (N=10)			**Julianapolder** (N=10)			**Delfzijl** (N=10)		
alpha-HCH	0	±	0	1,0	±	2,1	0	±	0	0	±	0
beta-HCH	1,5	±	0,3	1,9	±	0,6	1,1	±	0,4	1,6	±	1,2
gamma-HCH	0	±	0	0,9	±	1,8	0	±	0	0	±	0
HCH-Sum	1,5	±	0,3	3,8	±	4,0	1,1	±	0,4	1,6	±	1,2
ppDDE	23,1	±	6,4	17,1	±	6,4	47,9	±	41,7	60,1	±	22,5
ppDDT	0,1	±	0,3	0,7	±	1,0	0,9	±	1,0	0,7	±	0,9
ppDDD	3,4	±	0,8	1,6	±	0,3	2,3	±	1,5	0,9	±	0,6
DDT-Sum	26,6	±	7,0	19,3	±	6,4	51,0	±	43,4	61,7	±	22,7
6 PCB (law)	281,2	±	110,4	211,5	±	96,6	415,5	±	159,4	507,8	±	265,5
PCB-Sum	566,3	±	208,7	444,2	±	197,6	871,7	±	337,6	913,6	±	450,2
HCB	2,6	±	0,4	2,6	±	1,3	3,3	±	3,1	5,8	±	1,4
Chlordane-Nonachlor-Sum	1,4	±	1,9	4,0	±	1,1	2,8	±	1,2	0,4	±	0,6
Hg	222,1	±	65,4	246,6	±	47,2	165,4	±	47,2	131,0	±	34,2

Common Tern	**Balgzand** (N=10)			**Griend** (N=10)			**Schiermonnikoog**	**Delfzijl** (N=10)		
alpha-HCH	0	±	0	0	±	0	-	0	±	0
beta-HCH	2,0	±	1,0	1,6	±	0,3	-	2,0	±	0,6
gamma-HCH	0	±	0	0,1	±	0,2	-	0	±	0
HCH-Sum	2,0	±	1,0	1,7	±	0,4	-	2,0	±	0,6
ppDDE	47,9	±	20,4	47,7	±	13,7	-	63,8	±	27,2
ppDDT	0,4	±	0,7	0,1	±	0,3	-	0,5	±	1,3
ppDDD	4,5	±	1,6	2,4	±	0,8	-	1,5	±	1,4
DDT-Sum	52,8	±	21,5	50,1	±	13,6	-	65,8	±	28,3
6 PCB (law)	480,5	±	209,8	486,4	±	172,8	-	524,3	±	267,1
PCB-Sum	915,6	±	397,2	972,4	±	323,2	-	950,7	±	480,0
HCB	5,7	±	2,0	6,1	±	1,28	-	6,3	±	1,6
Chlordane-Nonachlor-Sum	0,0	±	0,1	2,3	±	0,5	-	0,1	±	0,3
Hg	208,5	±	51,8	282,6	±	50,3	-	308,9	±	63,3

Oystercatcher 2007

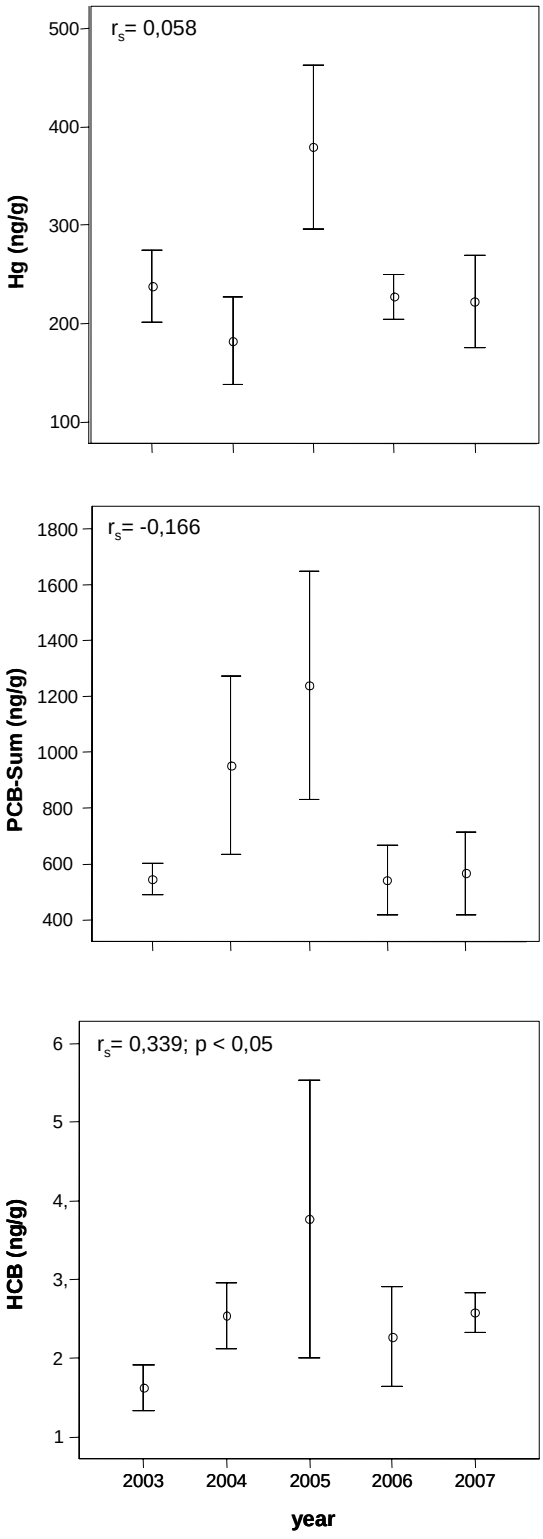


Common Tern 2007

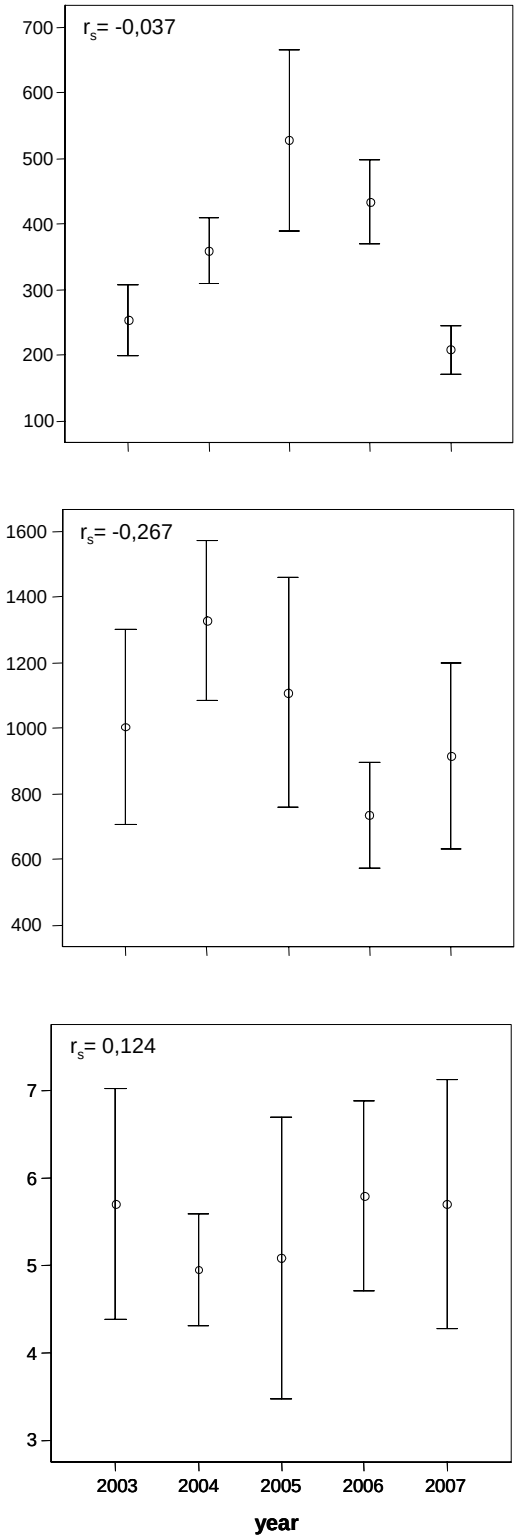


Balgzand

Oystercatcher

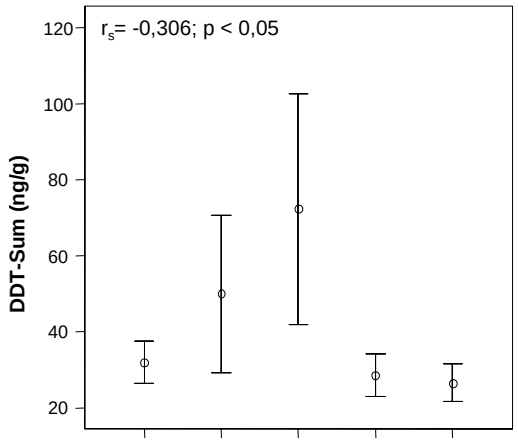


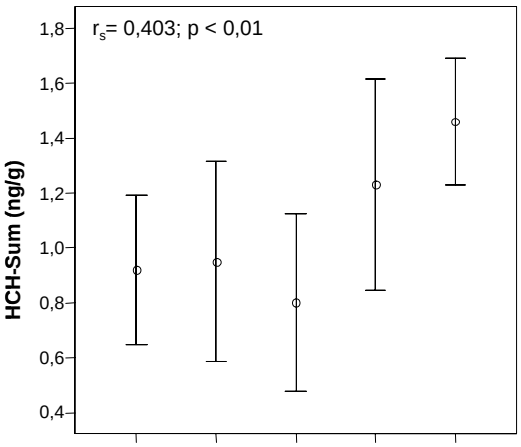
Common Tern

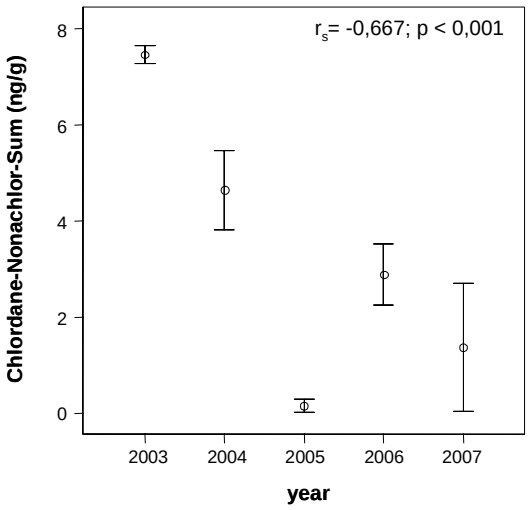


Balgzand

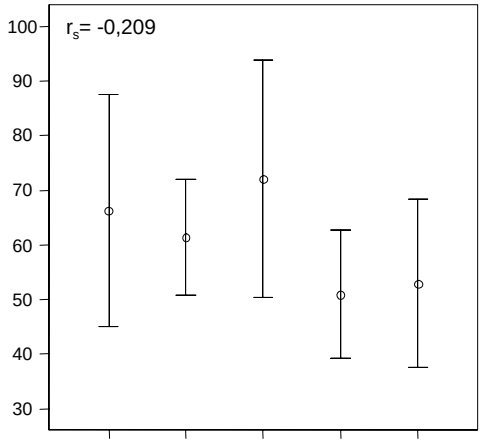
Oystercatcher

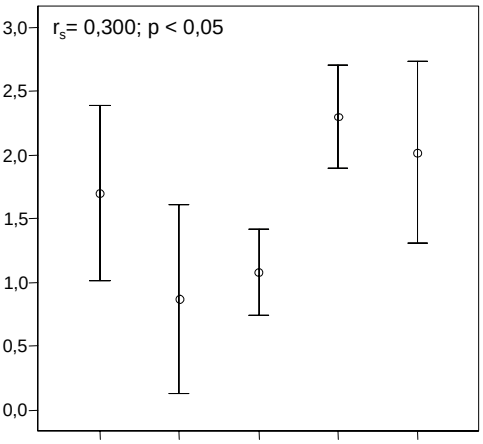


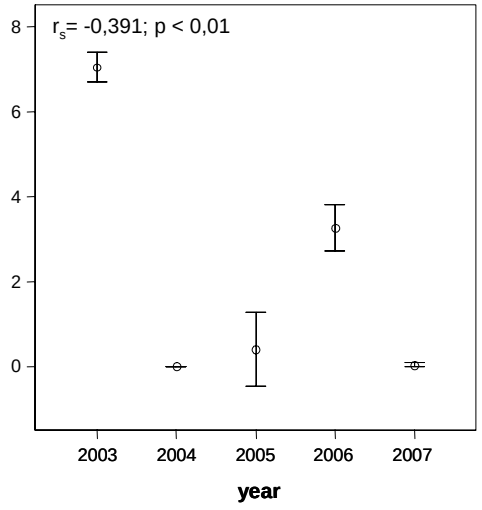




Common Tern

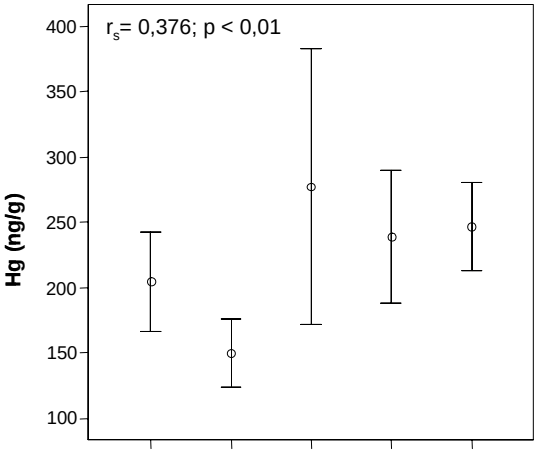


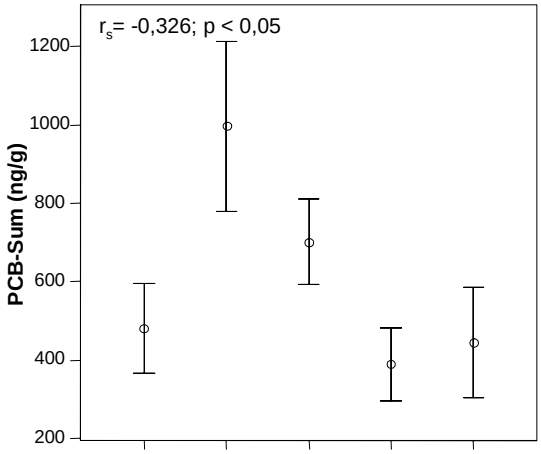


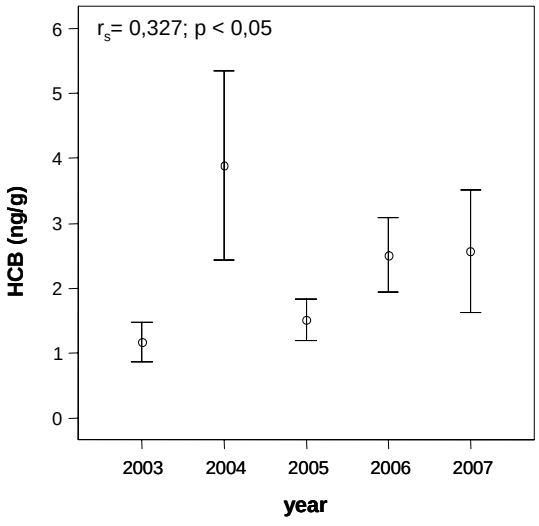


Griend

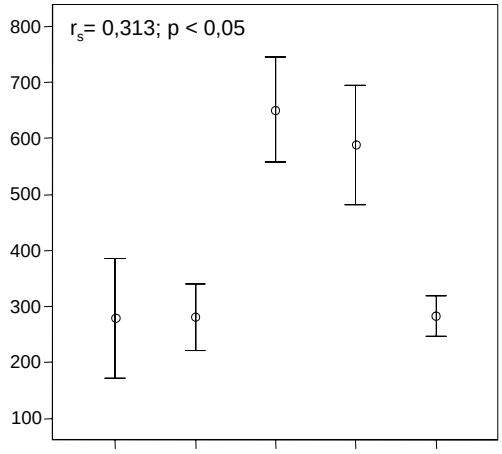
Oystercatcher

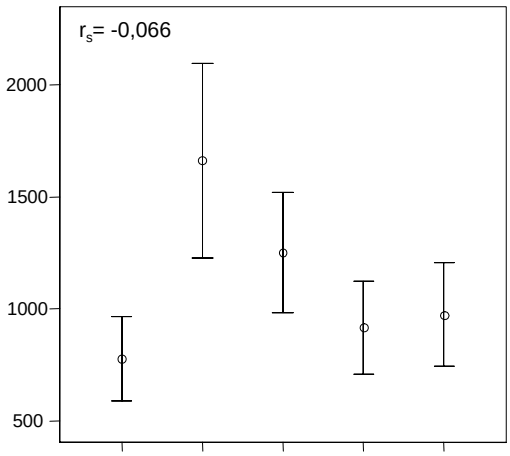


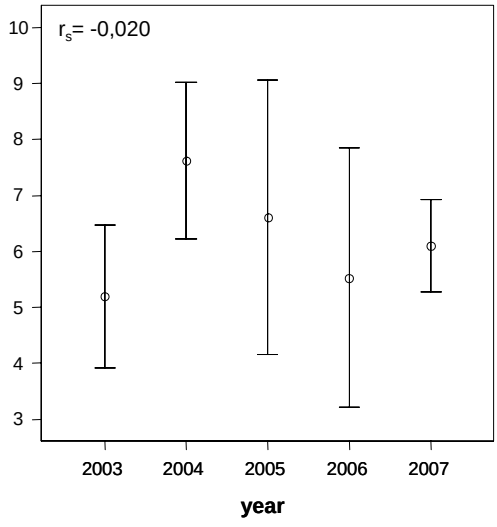




Common Tern

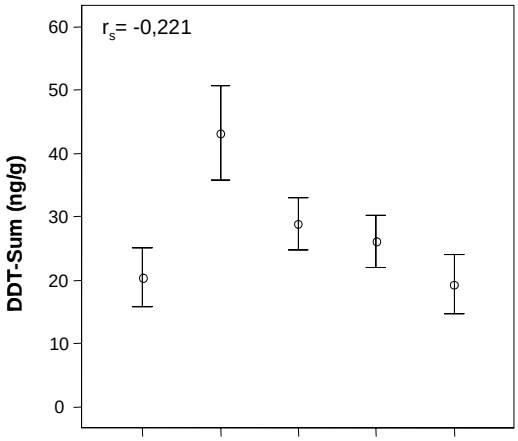


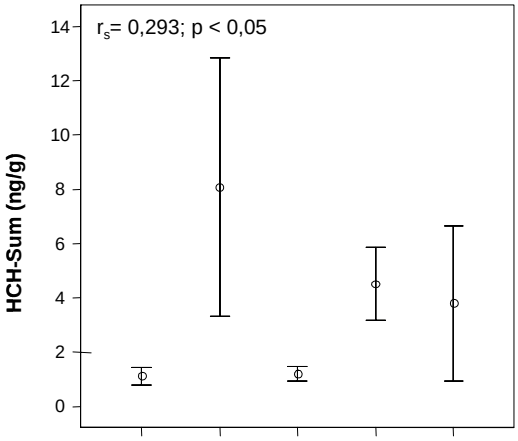


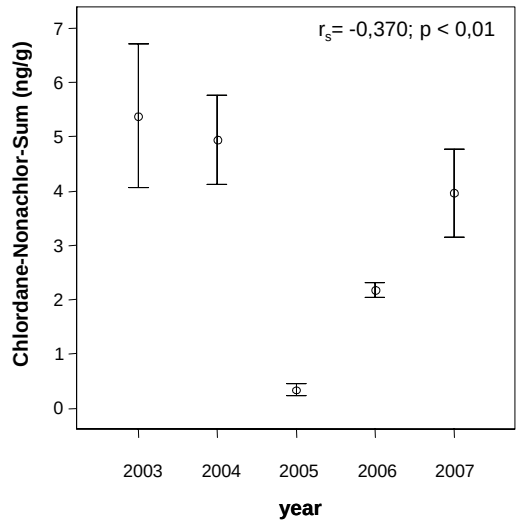


Griend

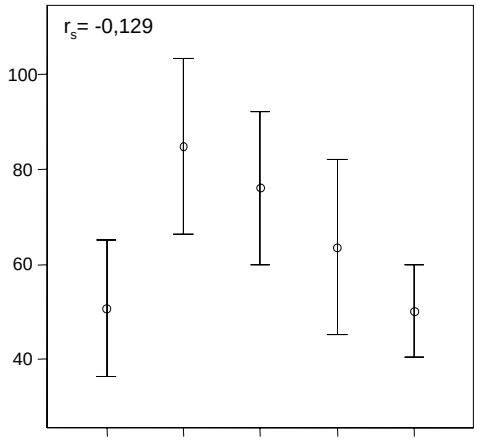
Oystercatcher

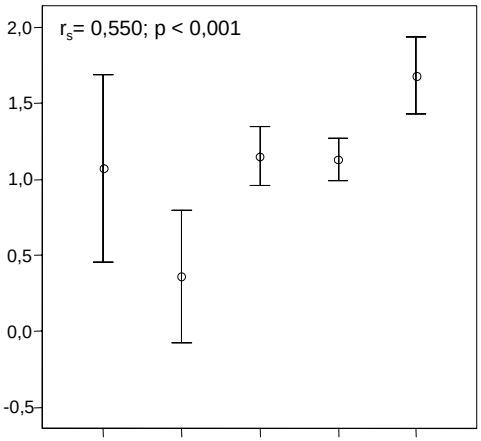


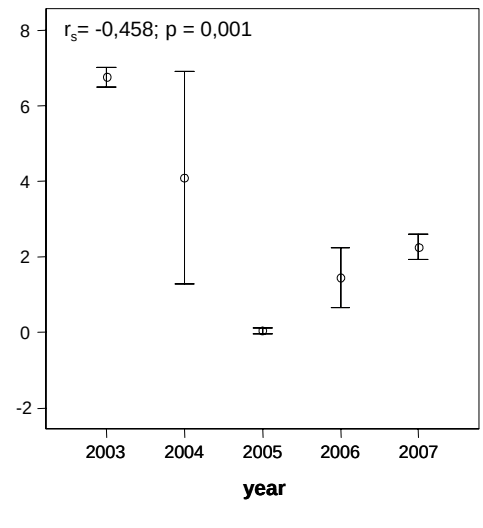




Common Tern

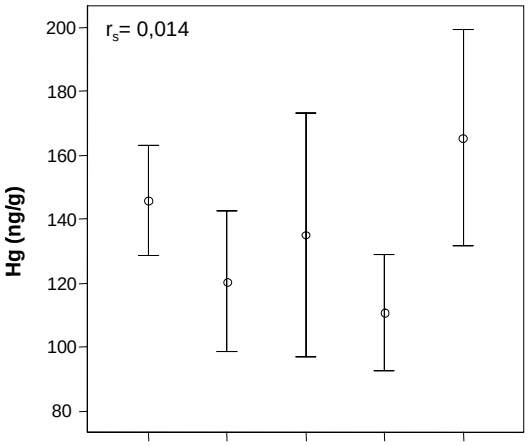


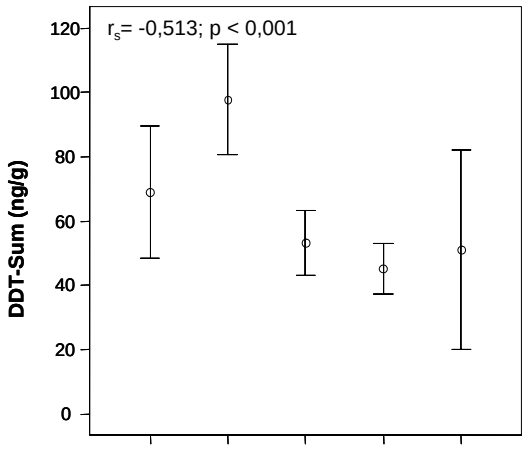


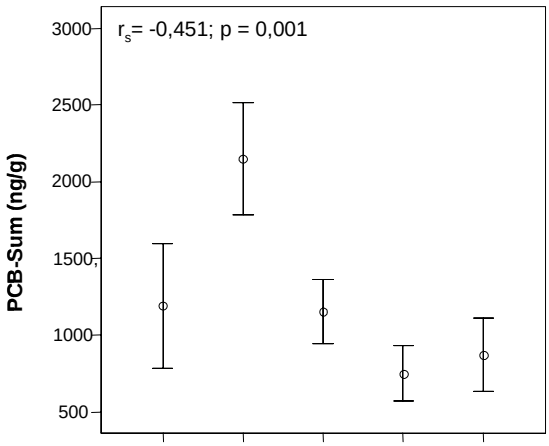


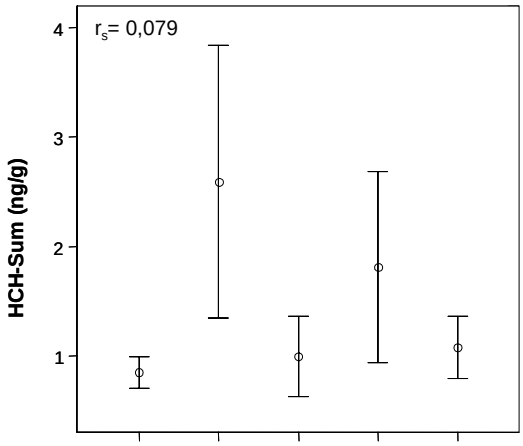
Julianapolder

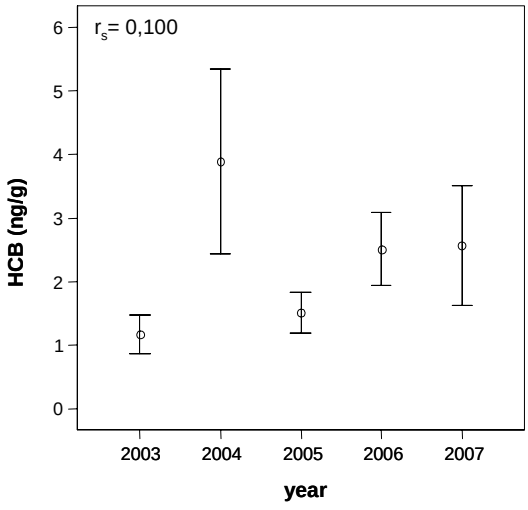
Oystercatcher

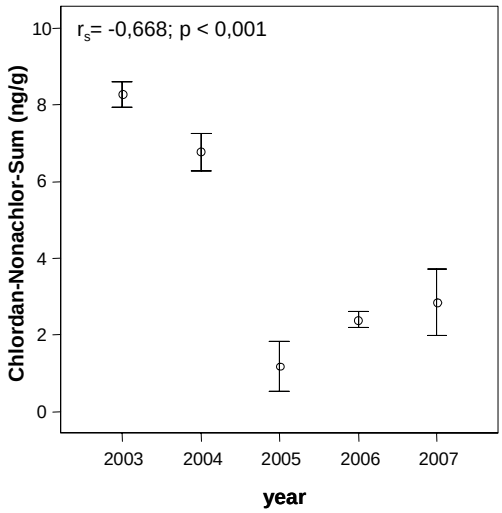












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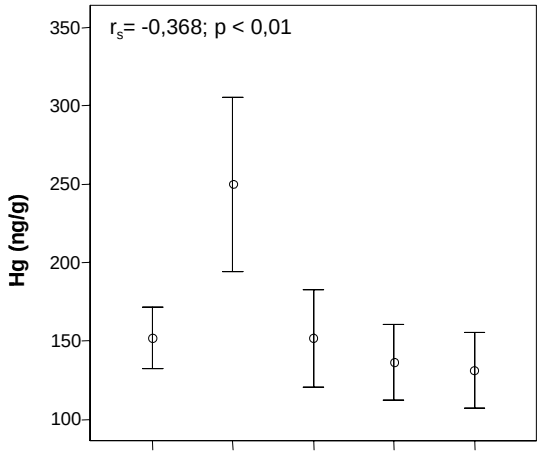

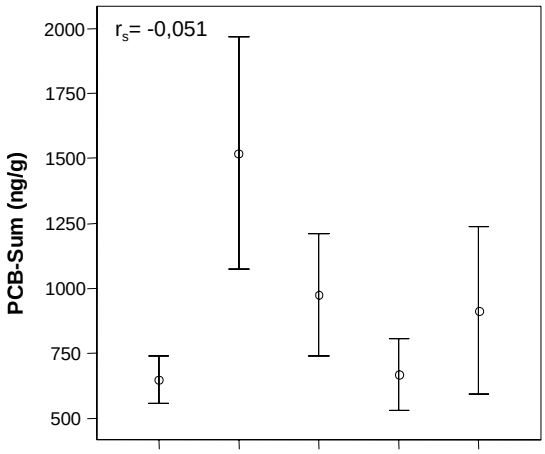

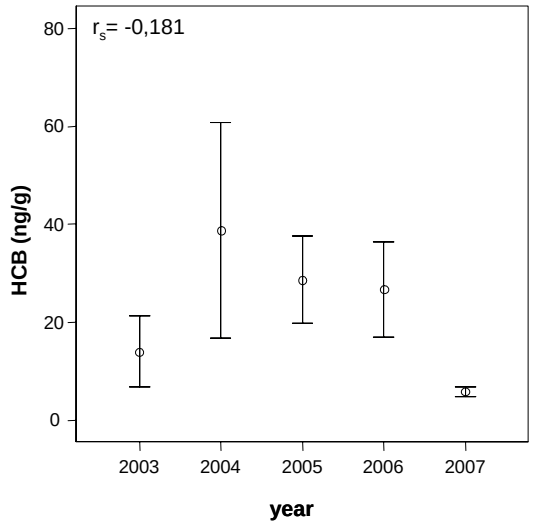

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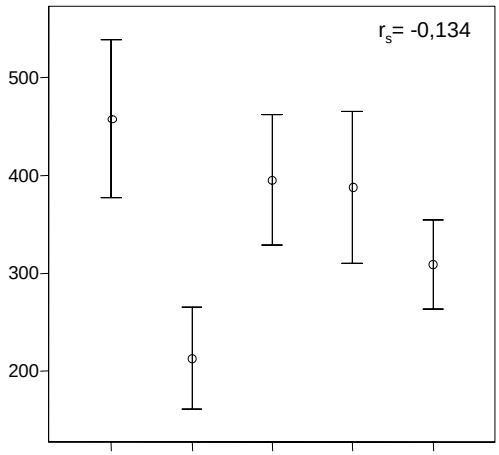

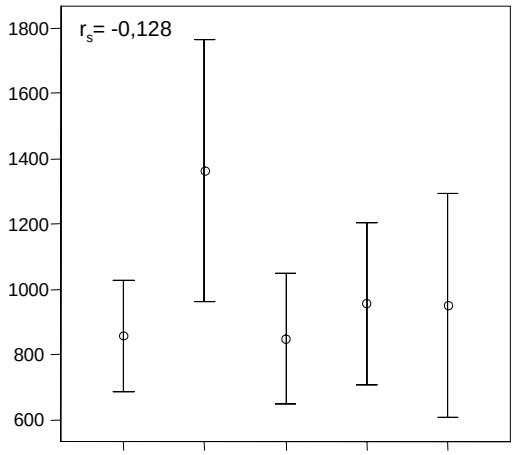

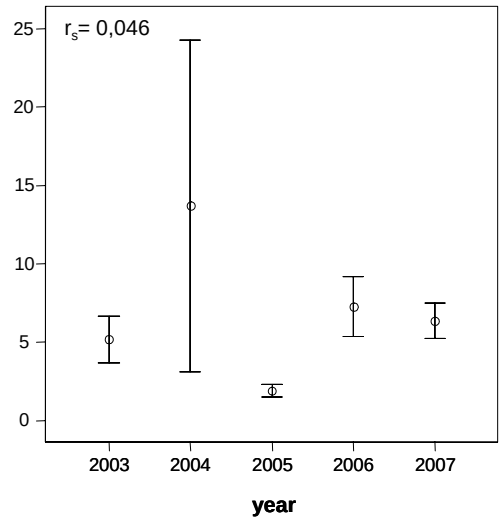

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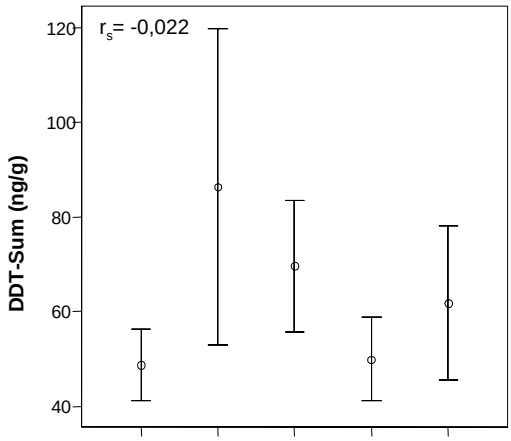

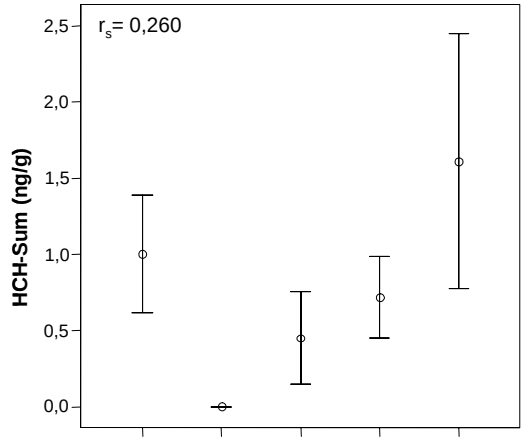

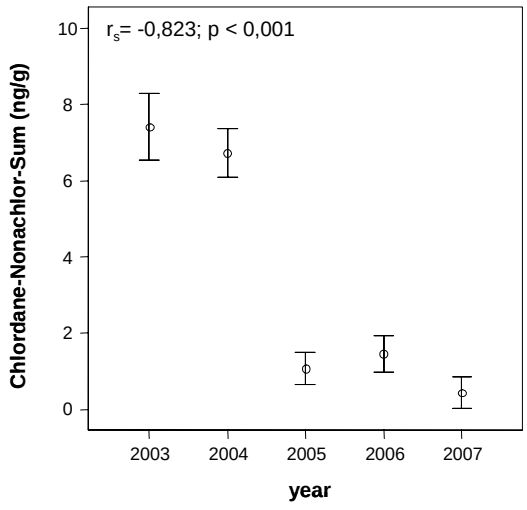

Common Tern