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 2006

1. Egg sampling

1.1 Sampling sites in the Wadden Sea in 2006

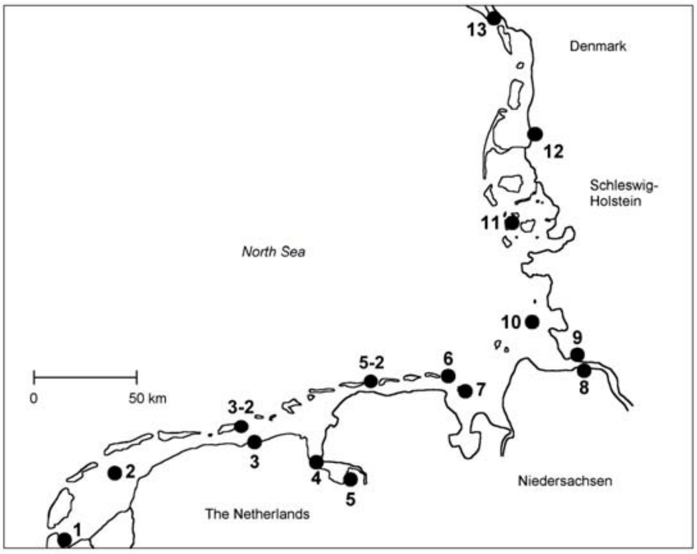


Fig. 1: TMAP parameter „Contaminants in bird eggs": Sampling sites of Oystercatcher and/or Common Tern eggs in the trilateral Wadden Sea. The Netherlands: 1 Balgzand, 2 Griend, 3 Julianapolder, 3-2 Schiermonnikoog, 4 Delfzijl; Germany, Lower Saxon: 5 Dollart, 5-2 Baltrum, 6 Minsener Oog, 7 Mellum (6 and 7 = Jade), 8 Hullen, 9 Neufelderkoog (8 and 9 = Elbe estuary); Germany, Schleswig Holstein: 10 Trischen, 11 Norderoog; 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 2006:

	Species	
Site	Oystercatcher	Common Tern
Balgzand	10	10
Griend	10	10
Julianapolder	10	
Schiermonnikoog		10
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 Nertherlands in 2006 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 2002 - 2006. 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 2002 - 2006

In 2006, in Oystercatcher eggs significantly lower mercury-, PCB- and DDT-levels than in 2005 were found. In Common Tern eggs significantly higher HCH- and Chlordane-levels were found.

Temporal Trends (see Enclosures):

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

Griend 2002 - 2006

In 2006, in Oystercatcher eggs significantly lower PCB-levels and higher HCB-, HCH- and Chlordane-levels were found than in 2005. Significantly higher Chlordane-levels were found in Common Tern eggs.

Temporal Trends:

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

Julianapolder/Schiermonnikoog 2002 - 2006

In 2006, in Oystercatcher eggs significantly lower PCB-levels and higher Chlordane-levels were found as in 2005. In Common Tern eggs significantly higher HCB-, HCH and Chlodane-levels were found.

Temporal Trends:

Oystercatcher	Significant **decreases** in the concentrations of mercury and Chlordane were identified.
Common Tern	Significant **increases** in the concentrations of HCH-levels and **decreases** in PCB-levels were detected.

Delfzijl 2002 - 2006

In 2006, in Common Tern eggs significantly higher HCB- and DDT-levels were found than in 2005.

Temporal Trends:

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

5.2. Spatial trends of selected contaminants in the Wadden Sea in 2006

In 2006, at all of the 13 for the TMAP parameter „Contaminants in bird eggs" selected sites, apart from Margrethekoog, eggs could be sampled and analysed (Fig. 1).

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

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

For Common Tern the intersite variation was even more distinct than for Oystercatcher. We identified areas with relatively high contaminations:

Mercury:	Neufelderkoog (Elbe)
PCB:	Neufelderkoog (Elbe)
HCB:	Neufelderkoog (Elbe), Trischen
DDT:	Neufelderkoog (Elbe), Trischen
HCH:	Neufelderkoog (Elbe), Trischen
Chlordane:	Balgzand

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 considerable higher concentrations of mercury in eggs from the Oystercatcher and the Common Tern found in Balgzand and Griend, compared to those found in the nearby areas of Julianapolder/Schiermonnikoog, Delfzijl and Dollart. The pattern for PCB and DDT in these areas are different and contamination is high here and decreases with increasing distance in both directions.

Mercury, DDT and PCB contamination of Oystercatcher eggs from Balgzand were significantly lower compared to last year and again showed distinct lower concentrations than those from the Elbe.

Chlordane concentrations of both analysed species where highest in Bagzand with the significantly highest concentrations in eggs of the Common Tern.

In Delfzijl Chlordane concentrations were particular low.

Like in the year before, the highest HCB-concentrations were found in Oystercatcher eggs collected in Delfzijl, indicating Delfzijl as the area with the highest HCB-contamination.

6. General Assessment

Results of 2006 again 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. Like in the past years, contamination levels originating from the river Elbe are decreasing continuously in northern and western directions.

High concentrations of mercury in Oystercatcher eggs from the western part of the Wadden Sea indicate a hot spot in the area of Balgzand, whereas PCB and DDT contamination was higher in the area Dollart. Like in the recent years the HCB contamination points to Delfzijl at the western Dollart as input source.

Compared to 2005, the high mercury, PCB and DDT concentrations decreased at Balgzand, whereas the high levels of of mercury analysed in Oystercatcher and the Common Tern eggs on Griend in 2005 were measured again in 2006. Although Chlordane concentrations are on a very low level, there was an increase of these chemicals measured in the eggs of both species in Balgzand as well as in Griend.

The increased input of environmental contaminants by the river Elbe in 2004, obviously had further decreased by 2006. Already in 2005 considerable lower concentrations where found in most areas. Also on Norderoog, where no eggs were collected in 2005, a decrease of mercury, PCB, DDT and Chlordane can be detected for 2006 compared to 2004. Increasing or stable concentrations at a high level were found for HCH at the Elbe, on Trischen and Norderoog.

Also in the western part of the Wadden Sea the concentrations had decreased again to levels of the years before 2005; in this year levels of some chemicals had been elevated. Especially for mercury, PCB, and DDT significant decreases were observed in Balzand, Griend, Julianapolder/ Schiermonnikoog, Delfzijl and Dollart. Fortunately this trend was observed for most of the contaminants in the different areas, giving an overall negative trend in 40 cases for the years 2002-2006, whereas only 13 positive trends were detected.

The 13 significant increases in analysed contaminant concentrations for the time span 2002 – 2006 were found for mercury (Oystercatcher Norderoog (due to the increase from 2002-2004)); Common Tern Balgzand, (due to the increase in 2004 and 2005), Griend (due to the increase in 2005); DDT (Oystercatcher Langlie (due to the increase 2004), Jade (due to the increase 2004 and 2005); Common Tern Trischen, HCH (Oystercatcher Trischen (increase in each year), Langlie; Common Tern Julianapolder (increase in 2006) Dollart (increase in 2006), Elbe (increase in 2003). Trischen (increase in 2004), Norderoog).

The trend monitoring shows again, how quickly changes in the environmental contamination with chemicals can be detected using the eggs of costal birds as indicators. Even years after banning, many chemicals can increase in there concentrations due to mobilisation. This shows that continous monitoring and, if necessary, additional actions have to be taken to detect and reduce the anthropogenic input of chemicals 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 2006
8.2 Spatial trends of selected contaminants in the trilateral Wadden Sea 2006 in Oystercatcher and Common Tern eggs
8.3 Temporal trends at each site, 2002 – 2006

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

Wilhelmshaven, 13 February 2007

(Prof. Dr. Peter H. Becker)

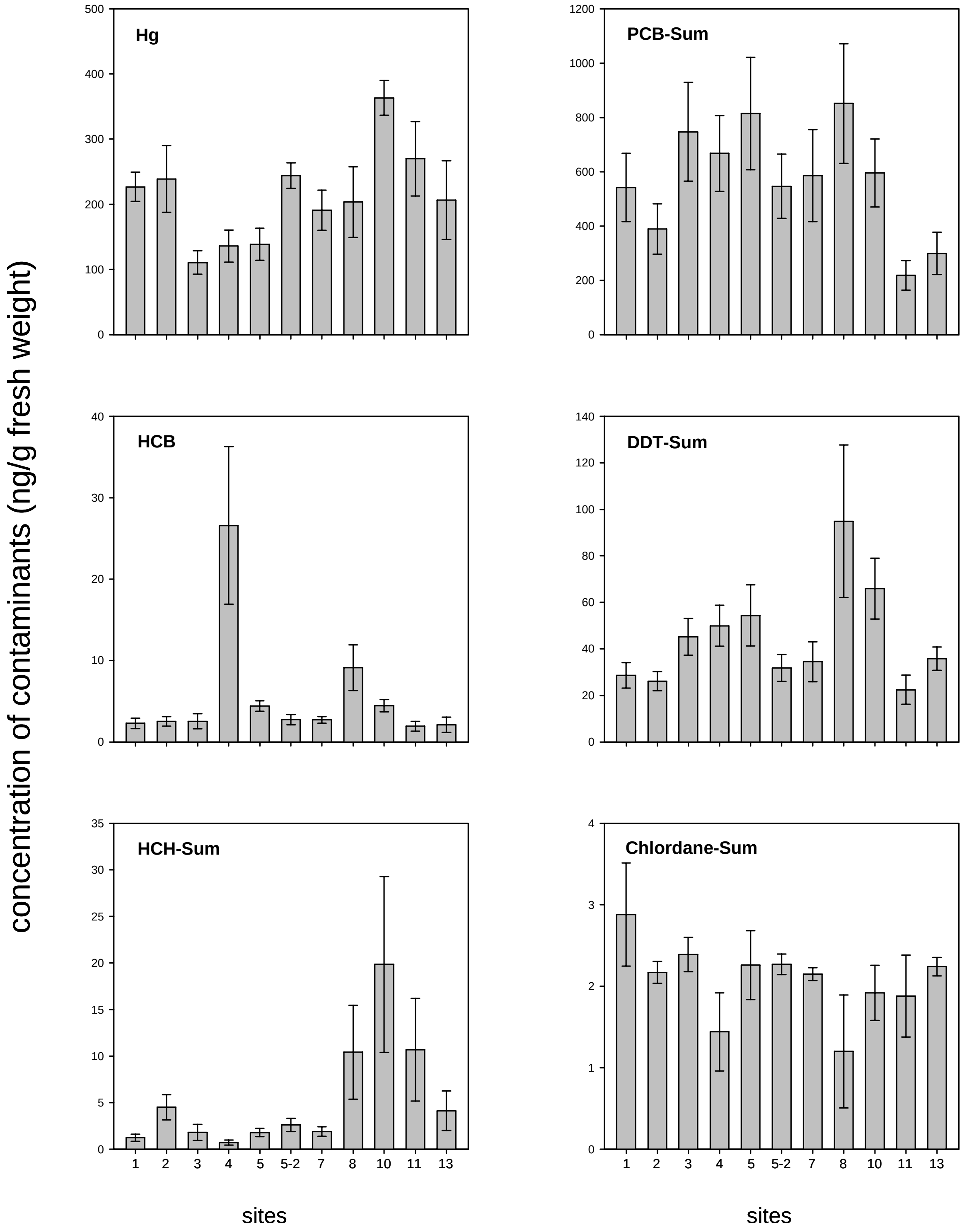
8.1 Contaminants in bird eggs 2006 in The Netherlands

Table 1: Concentrations of chemicals in Oystercatcher and Common Tern eggs sampled in The Netherlands in 2006. Mean concentrations in ng · g^{-1} (fresh mass of egg content), standard deviations and number of samples are presented.

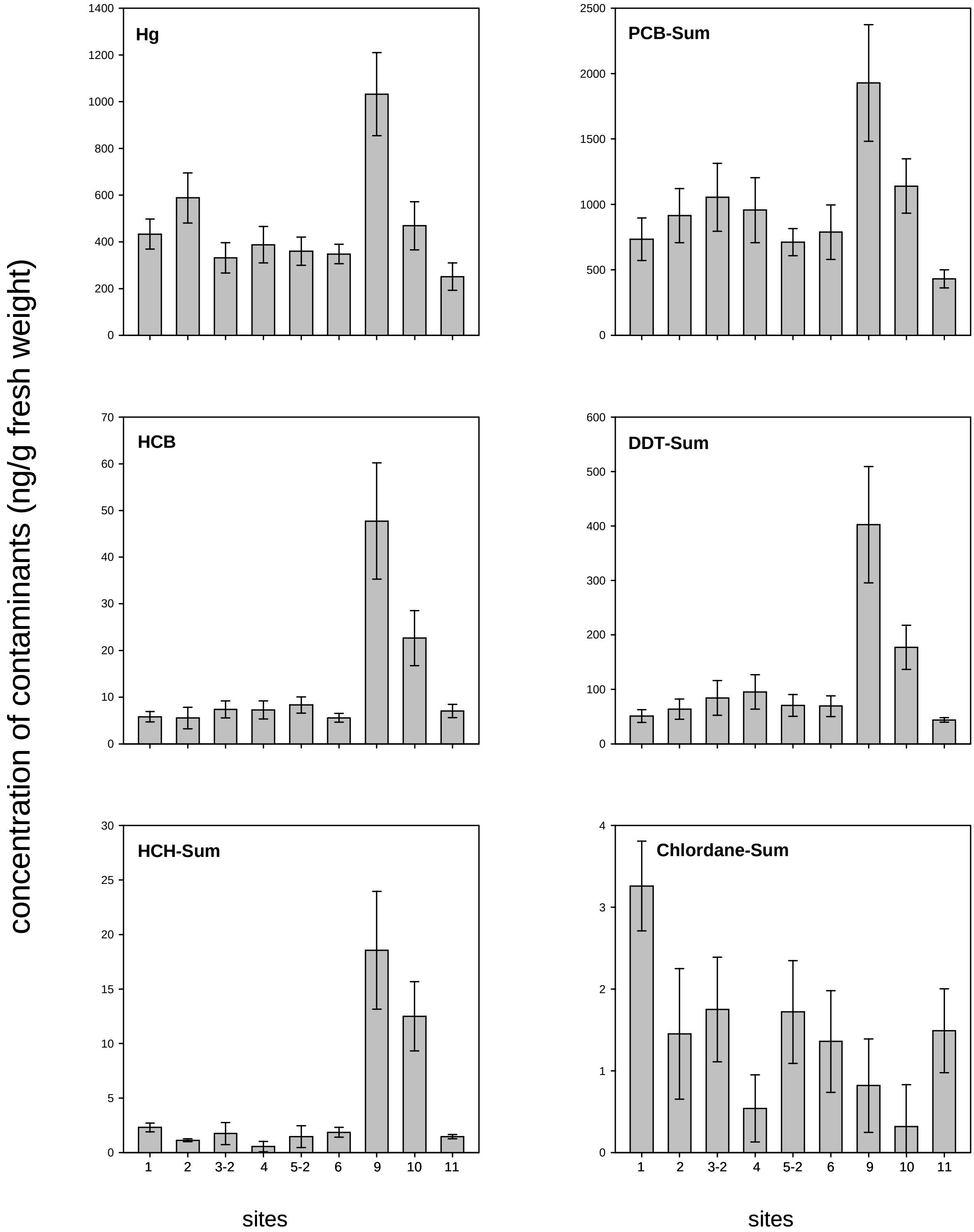
Oystercatcher	Balgzand (N=10)			Griend (N=10)			Julianapolder (N=10)			Delfzijl (N=10)		
alpha-HCH	0,0	±	0,0	0,0	±	0,0	0,0	±	0,0	0,0	±	0,0
beta-HCH	1,2	±	0,5	4,1	±	2,0	1,8	±	1,2	0,7	±	0,4
gamma-HCH	0,0	±	0,0	0,4	±	0,7	0,0	±	0,0	0,0	±	0,0
HCH-Sum	1,2	±	0,5	4,5	±	1,9	1,8	±	1,2	0,7	±	0,4
ppDDE	22,9	±	7,5	21,1	±	5,6	40,0	±	10,9	44,1	±	11,9
ppDDT	4,5	±	0,2	4,0	±	0,2	4,1	±	0,2	4,6	±	0,4
ppDDD	1,3	±	0,1	0,9	±	0,1	1,1	±	0,1	1,2	±	0,2
DDT-Sum	28,6	±	7,7	26,1	±	5,7	45,2	±	11,0	49,9	±	12,3
6 PCB (law)	264,8	±	93,3	190,9	±	66,1	376,6	±	127,2	347,3	±	104,0
PCB-Sum	542,3	±	175,3	389,1	±	129,8	747,3	±	253,6	667,7	±	195,1
HCB	2,3	±	0,9	2,5	±	0,8	2,5	±	1,3	26,6	±	13,6
Chlordane-Nonachlor-Sum	2,9	±	0,9	2,2	±	0,2	2,4	±	0,3	1,4	±	0,7
Hg	226,9	±	31,4	238,9	±	71,2	110,8	±	25,3	136,2	±	34,3

Common Tern	Balgzand (N=10)			Griend (N=10)			Schiermonnikoog (N=10)			Delfzijl (N=10)		
alpha-HCH	0,0	±	0,0	0,0	±	0,0	0,0	±	0,0	0,0	±	0,0
beta-HCH	1,5	±	0,7	1,1	±	0,2	1,3	±	1,2	0,6	±	0,7
gamma-HCH	0,8	±	0,3	0,0	±	0,0	0,4	±	0,7	0,0	±	0,0
HCH-Sum	2,3	±	0,6	1,1	±	0,2	1,8	±	1,4	0,6	±	0,7
ppDDE	48,7	±	15,0	59,3	±	25,1	83,1	±	44,7	89,1	±	44,5
ppDDT	0,4	±	1,3	2,7	±	1,9	0,0	±	0,0	4,4	±	0,1
ppDDD	1,8	±	0,9	1,5	±	0,6	1,2	±	0,4	1,8	±	1,4
DDT-Sum	50,9	±	16,4	63,6	±	25,7	84,3	±	44,5	95,3	±	44,5
6 PCB (law)	372,6	±	115,3	470,9	±	148,6	531,7	±	187,4	498,1	±	179,1
PCB-Sum	734,2	±	226,9	915,0	±	288,8	1055,0	±	362,6	956,2	±	347,2
HCB	5,8	±	1,5	5,5	±	3,2	7,4	±	2,6	7,3	±	2,7
Chlordane-Nonachlor-Sum	3,3	±	0,8	1,5	±	1,1	1,8	±	0,9	0,5	±	0,6
Hg	433,1	±	89,8	588,0	±	150,1	331,7	±	90,9	387,5	±	109,0

Oystercatcher 2006

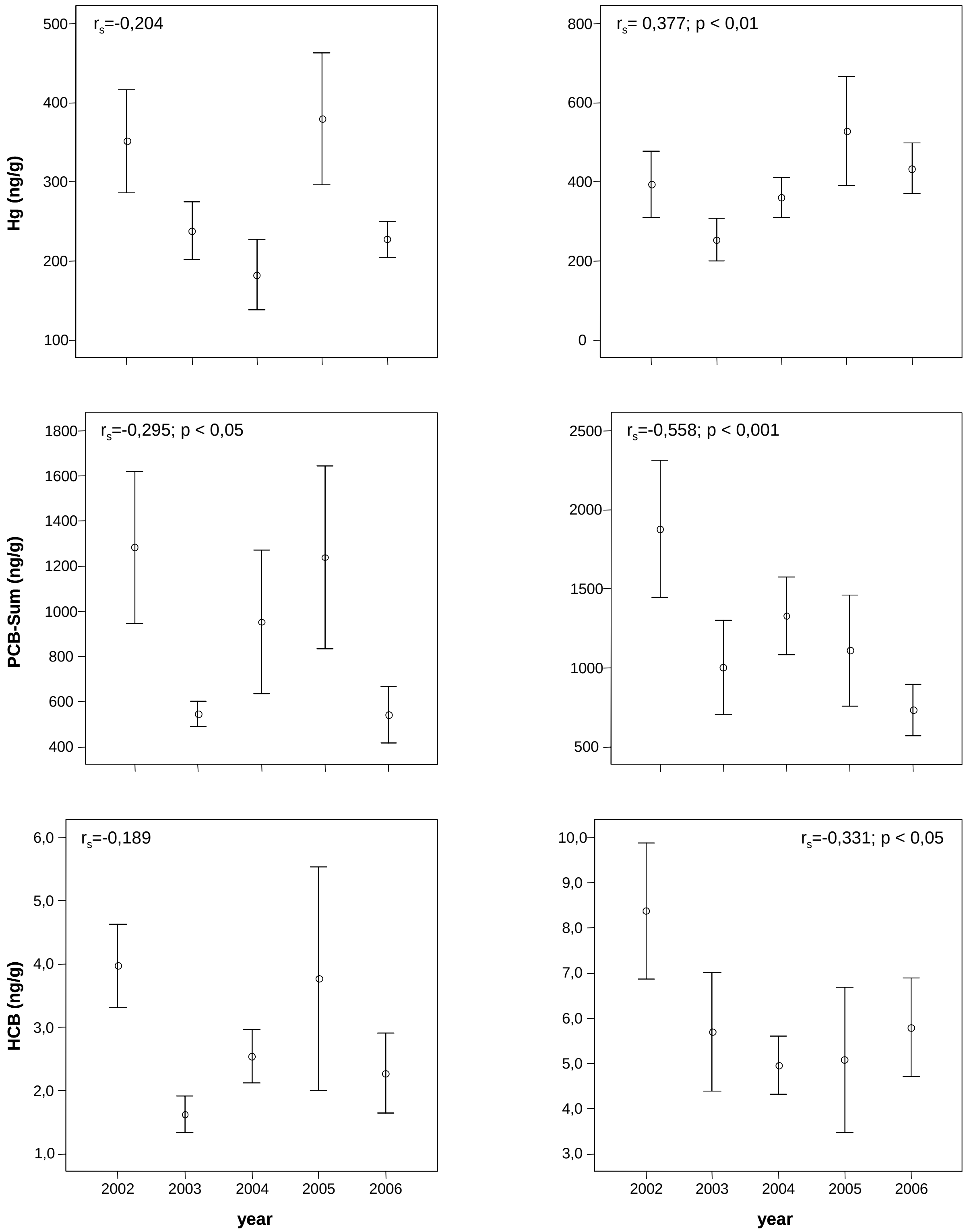


Common Tern 2006



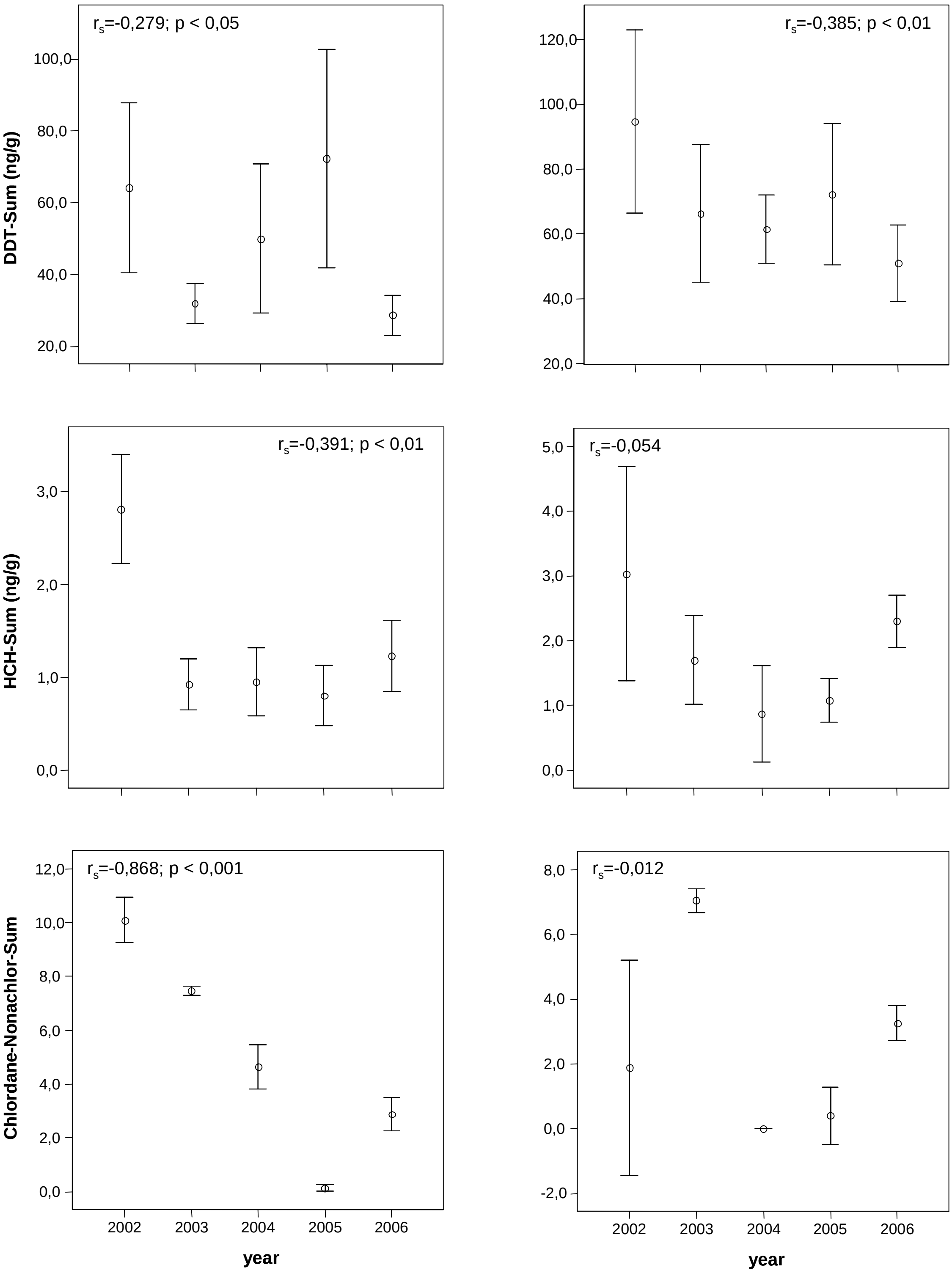
Balgzand

Oystercatcher | Common Tern



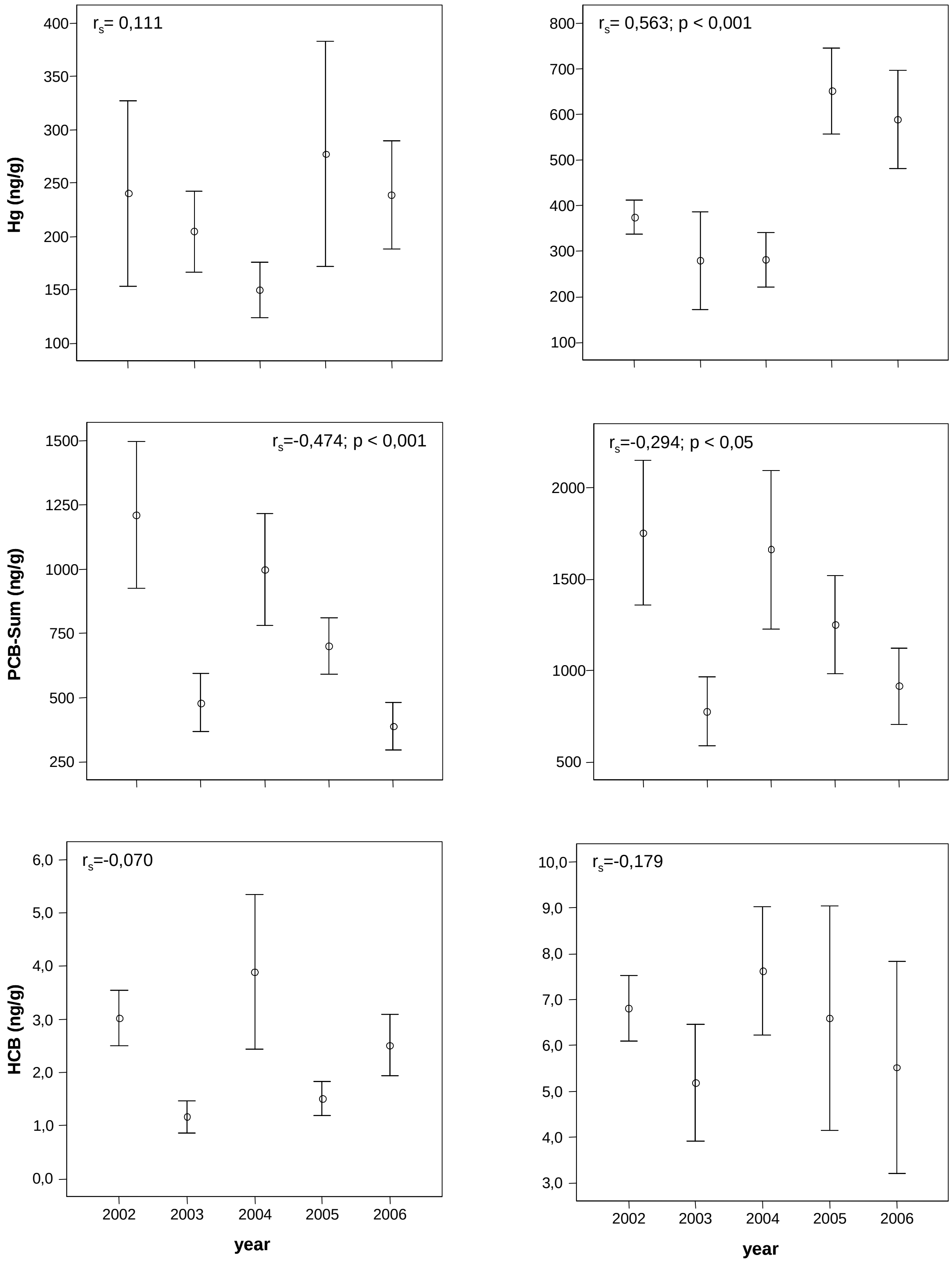
Balgzand

Oystercatcher   Common Tern



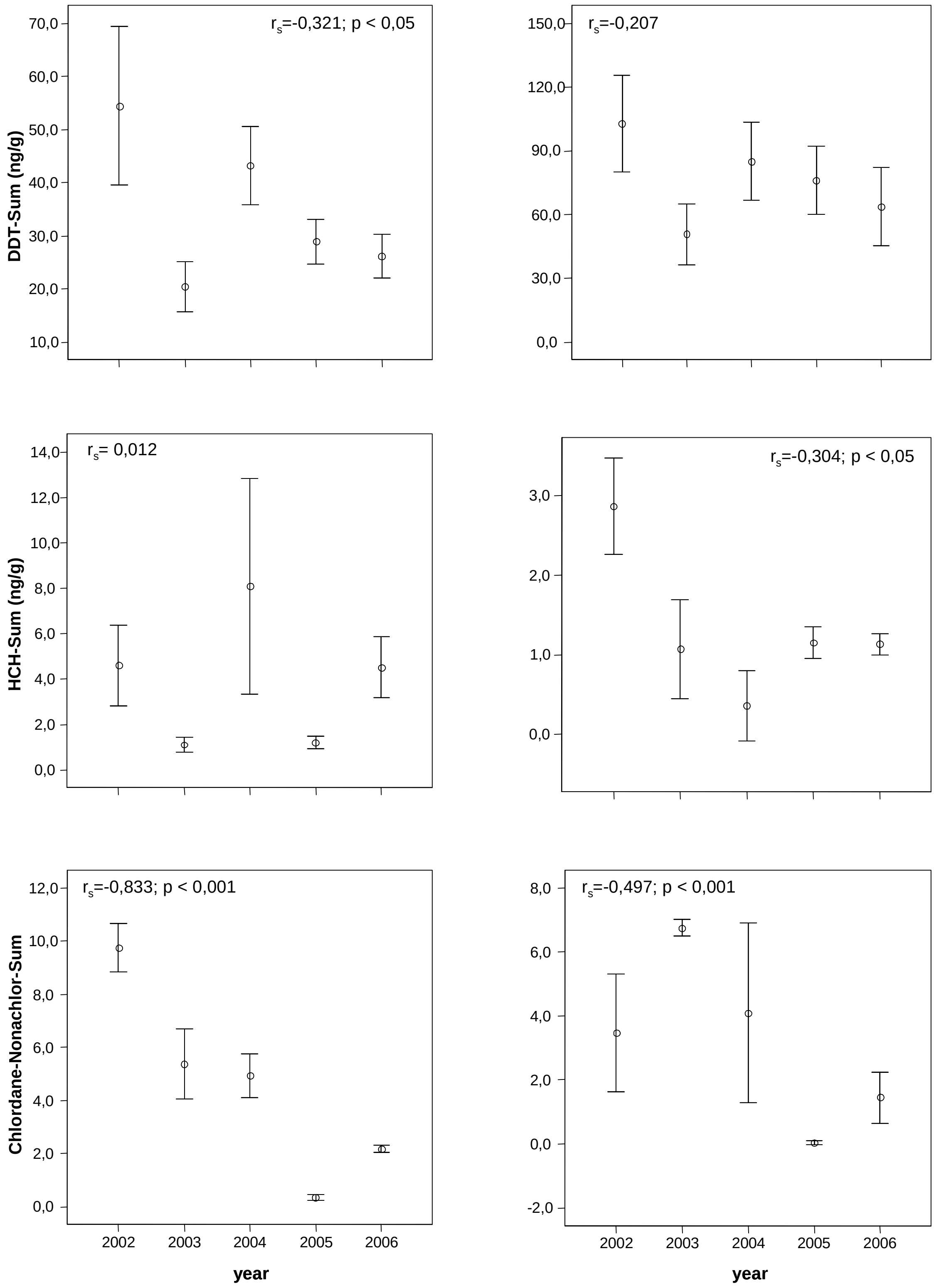
Griend

Oystercatcher | Common Tern



Griend

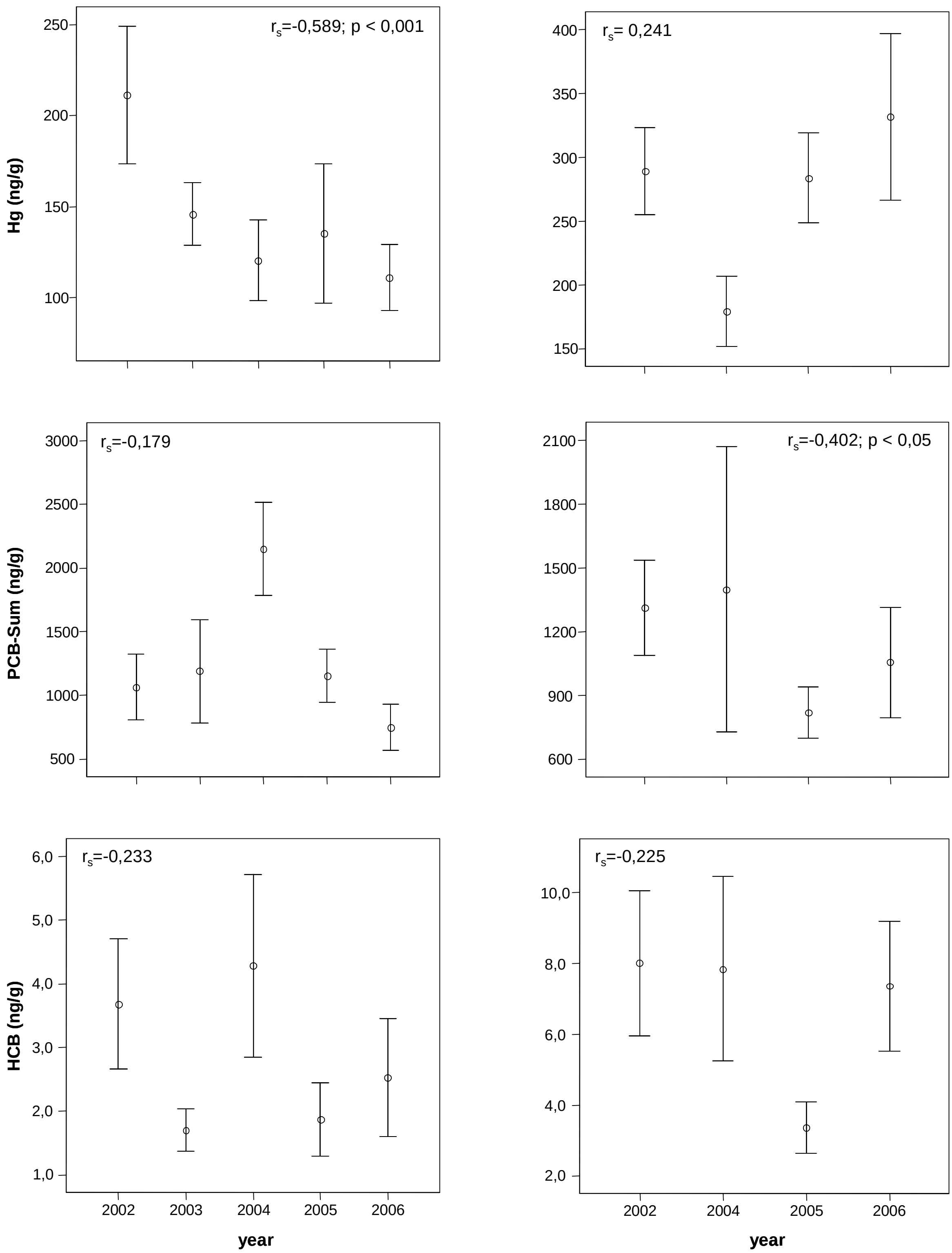
Oystercatcher   Common Tern



Julianapolder

Oystercatcher

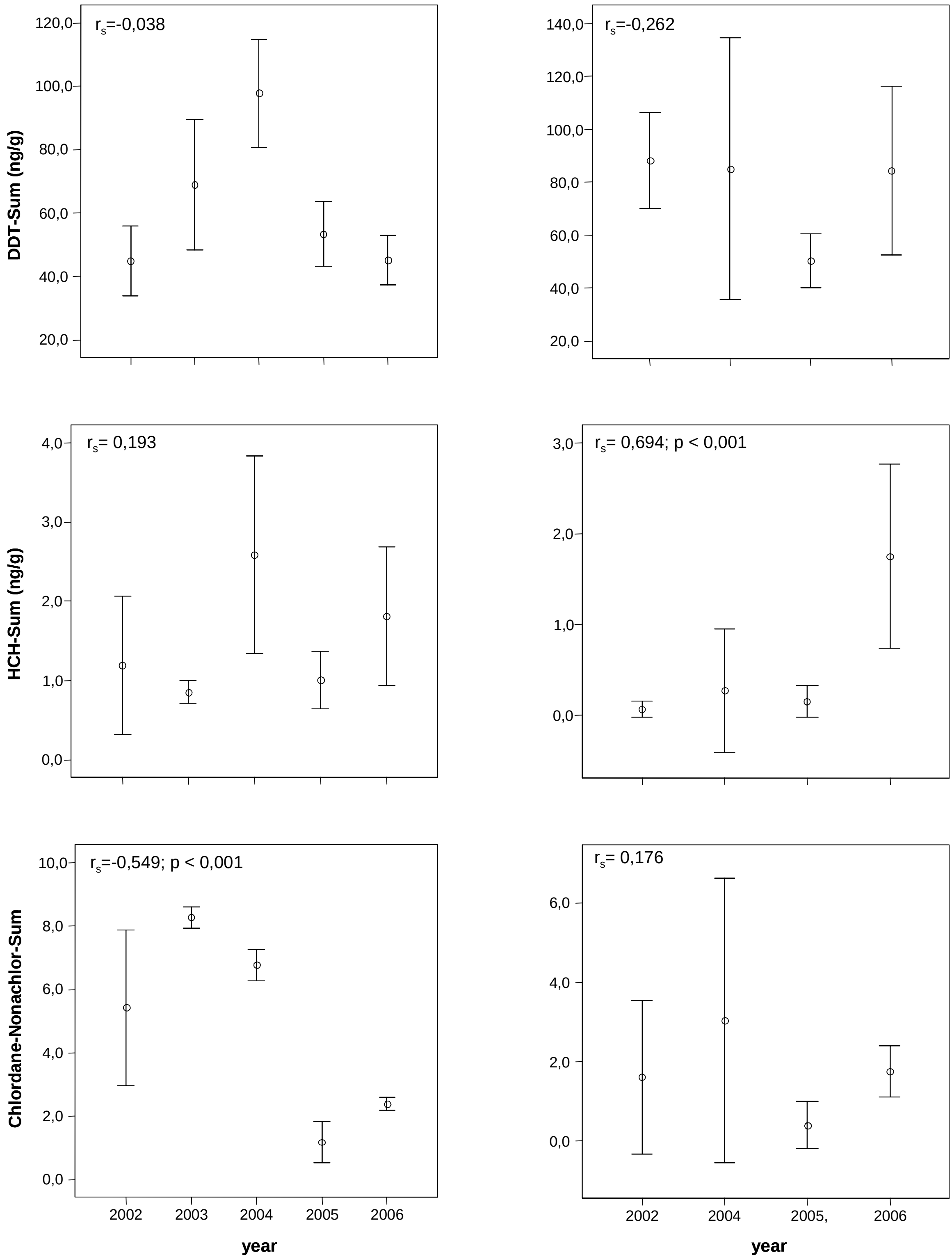
Common Tern



Julianapolder

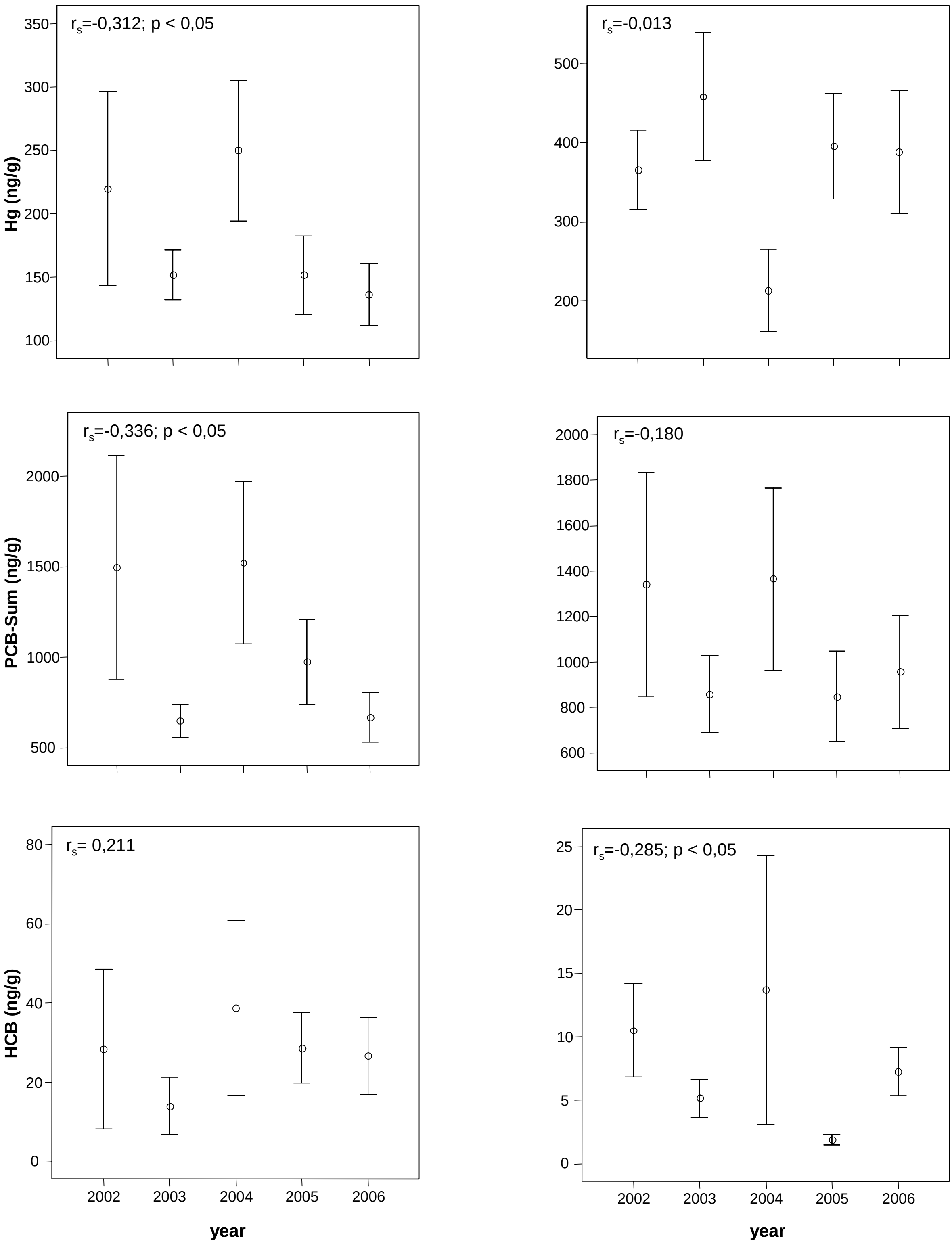
Oystercatcher

Common Tern

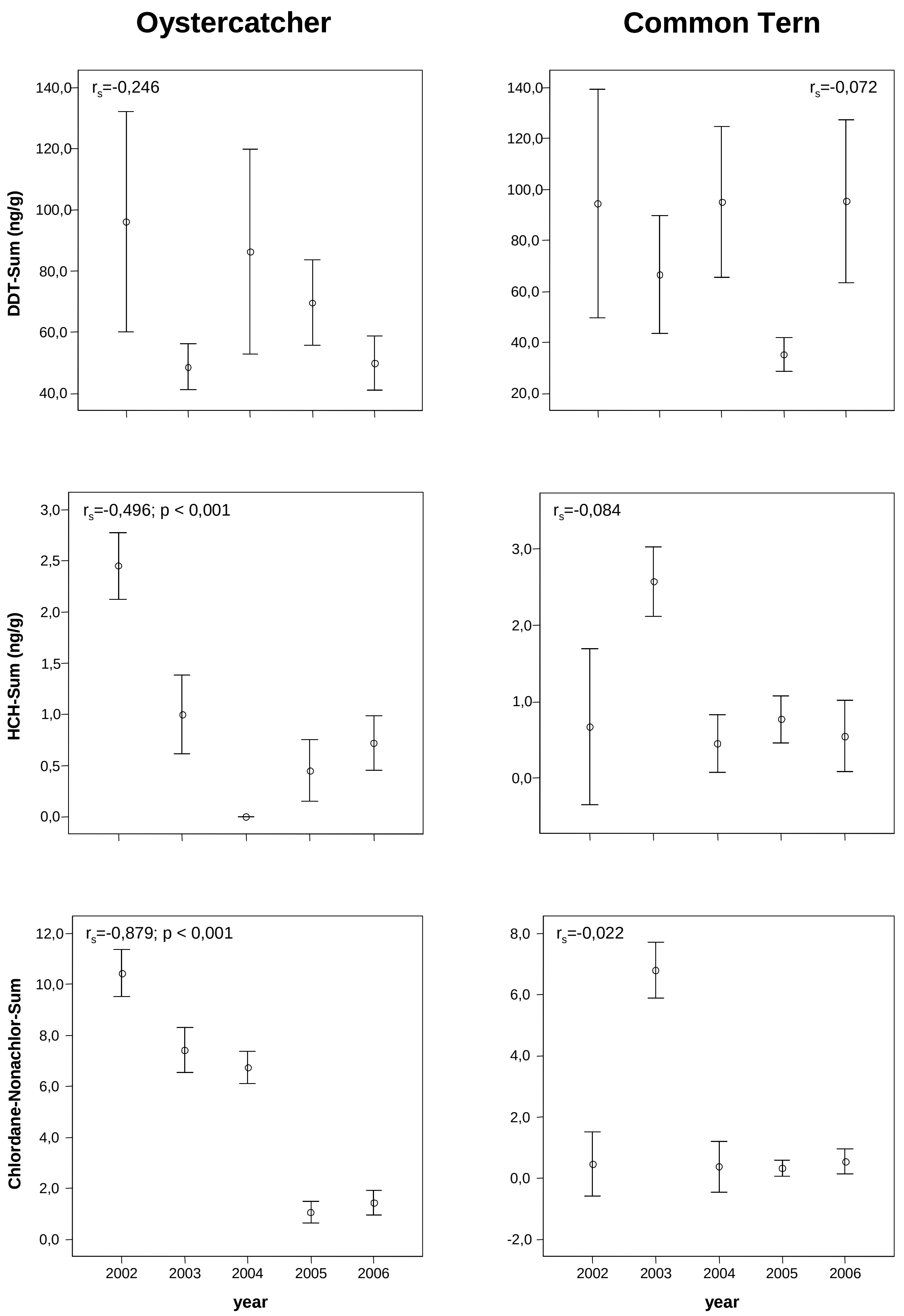


Delfzijl

Oystercatcher | Common Tern



Delfzijl


Oystercatcher
Common Tern
DDT-Sum (ng/g)
HCH-Sum (ng/g)
Chlordane-Nonachlor-Sum
rs=-0,246
rs=-0,072
rs=-0,496; p < 0,001
rs=-0,084
rs=-0,879; p < 0,001
rs=-0,022
140,0
120,0
100,0
80,0
60,0
40,0
20,0
3,0
2,5
2,0
1,5
1,0
0,5
0,0
12,0
10,0
8,0
6,0
4,0
2,0
-2,0
2002
2003
2004
2005
2006
year