ICBM - Institut für Chemie und Biologie des Meeres, Schleusenstraße 1, D-26382 Wilhelmshaven

Documentation of the TMAP Parameter "Pollutants in seabird eggs" in The Netherlands in 2015

1. Egg sampling

Eggs were sampled according to OSPAR (1997), Becker et al. (2001) and VDI (2009). In general, per year, species and site, 10 eggs were sampled (cf. Fig. 1.1 and Table 1.1).

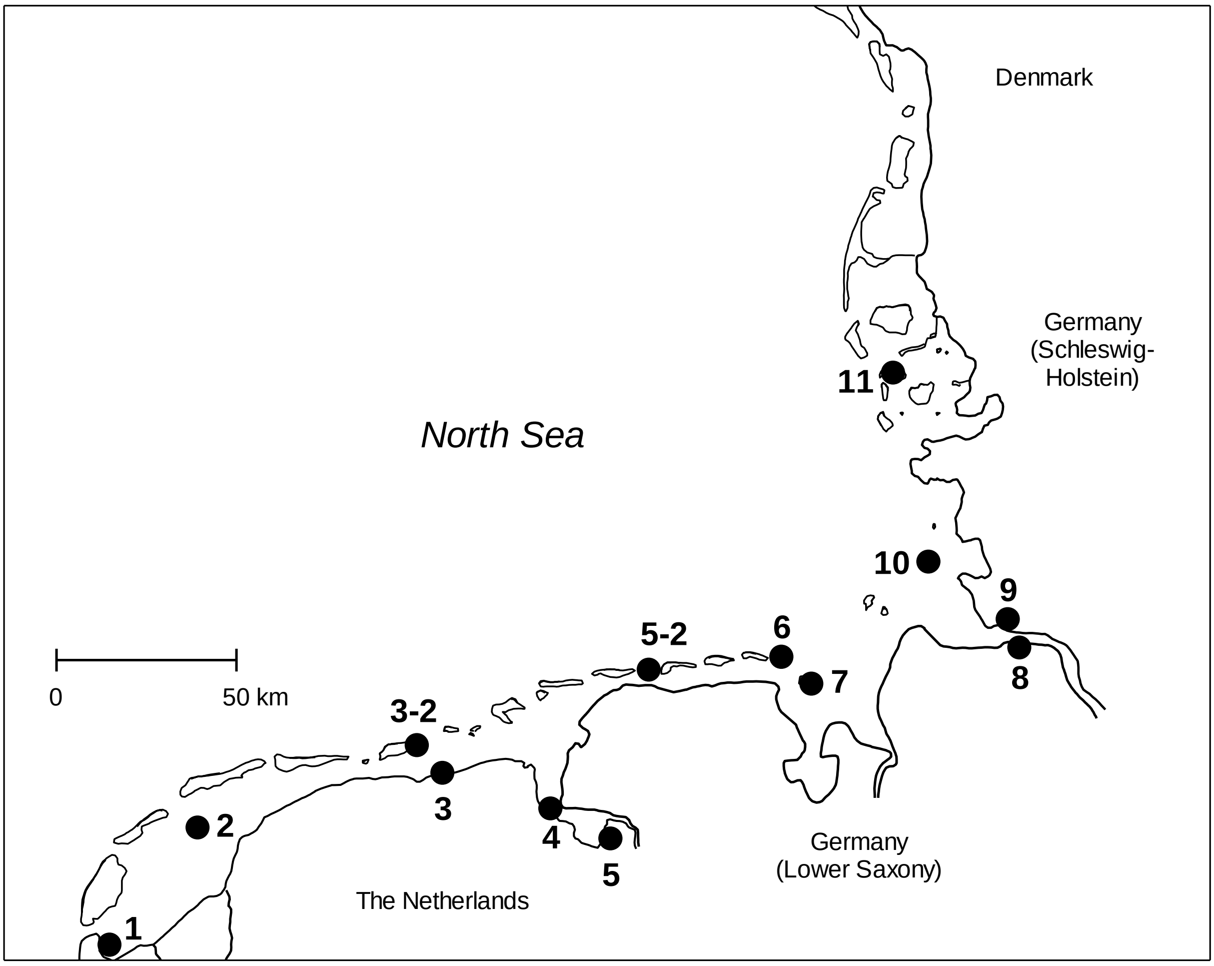

Fig. 1.1: Sampling sites of Oystercatcher and/or Common Tern eggs in the trilateral Wadden Sea. The Netherlands: 1 Balgzand, 2 Griend, 3 Julianapolder, 3-2 Schiermonnikoog, 4 Delfzijl; Germany, Lower Saxony: 5 Dollart, 5-2 Baltrum, 6 Minsener Oog (Oldeoog), 7 Mellum (6 and 7 = Jade), 8 Hullen, 9 Neufelderkoog (8 and 9 = Elbe estuary); Germany, Schleswig Holstein: 10 Trischen, 11 Norderoog/Hallig Hooge (Halligen). At sites 3, 5, 7 and 8 only Oystercatcher eggs, at sites 3-2, 6 and 9 only Common Tern eggs were taken.

Table 1.1: Number of Oystercatcher and Common Tern eggs sampled per site in 2015

	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 OSPAR (1997), 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 2015 are documented in an EXCEL-file (already sent on disc). 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 presented statistics for the following most important chemicals or chemical groups:

ORGANOCHLORINES:

PCB sum 62 congeners

6PCBs 6 PCB-congeners (PCB28, PCB52, PCB101, PCB138, PCB153, PCB180)

HCB

HCH sum α-HCH, β-HCH, γ-HCH

DDT sum p,p'-DDE, p,p'-DDT, p,p'-DDD

Chlordane sum Sum of Chlordan and Nonachlor-compounds: trans-Chlordan, cis-Chlordan, trans-Nonachlor, cis-Nonachlor

To make the following text more readable, for "PCB sum" the simplifying term "PCB", for "DDT sum" the term "DDT", for "HCH sum" the term "HCH" and for "Chlordane sum" the term "Chlordanes" is used.

To calculate TEQs (Toxic Equivalents) of non- and mono-ortho PCB congeners, bird-specific 2,3,7,8-TCDD toxic equivalency factors (TEF) proposed by the WHO (Van den Berg et al., 1998) were used. Non-ortho congeners detected were PCB 126 and 169, mono-ortho congeners were PCB105, 114, 118, 123,156, 157, 167 and 189.

HEAVY METALS:

Hg (mercury)

All concentrations are given in ng/g fresh weight of the eggs with an accuracy of one digit after the decimal point (which is shown as a comma).

Statistics:

For analyzing temporal trends for the years 2011 – 2015, Spearman rank correlations were calculated (two-tailed) for the years 2011 - 2015. To identify potential differences in pollutant concentrations between 2014 and 2015, Mann-Whitney-U-tests were conducted. 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 Spatial patterns of selected contaminants in the Wadden Sea in 2015

For the Oystercatcher, we identified the following areas with relatively high contamination. They are listed in order of mean contamination level, beginning with the highest (see Abb. 5.1.1; Tab. 8.1.1):

Hg:	Griend, Jade, Halligen
PCB:	Elbe, Dollart, Julianapolder
HCB:	Delfzijl, Elbe, Griend
DDT:	Elbe, Trischen, Dollart
HCH:	Griend, Elbe, Trischen
Chlordane:	Dollart, Julianapolder, Balgzand

In Common Tern eggs, concentrations of Hg, PCB, HCB and DDT tended to be higher at most sites than in Ostercatcher eggs, whereas HCH and Chlordane concentrations tended to be lower. But the PCB conentrations reached equal values in some areas. In general in 2015 the differences between the two species were again more distinct compared to 2014 and more similar to the years before. In the following areas relatively high contaminations of Common Tern eggs were detected (given in the order of contamination level, beginning with the highest average level, see Abb. 5.1.1; Tab. 8.1.1):

Hg:	Elbe, Delfzijl, Halligen
PCB:	Elbe, Trischen, Schiermonnikoog
HCB:	Elbe, Jade, Schiermonnikoog
DDT:	Elbe, Trischen, Schiermonnikoog
HCH:	Elbe, Trischen, Halligen
Chlordane:	Schiermonnikoog, Halligen, Griend

In the **Oystercatcher**, the geographical pattern of **Hg** concentrations in 2015 was largely similar to those of the years before (see last reports) in the western parts: Again **Hg** peaked at Griend and showed low concentrations at the Dollart and Julianapolder. In contrast to the years before high Hg concentrations occurred in the eastern part in eggs from Jade and Halligen whereas eggs from the river Elbe had only low concentrations. But we see the same trend as the years before: Because of the rising concentrations in formerly lower contaminated areas the differences between the areas seemed to be lower. This development may result in an established level of a little less than 200 ng/g **Hg** in

Oystercatcher eggs from all investigated areas of the Wadden Sea. In 2015 the average measured Hg concentration in Oystercatcher eggs from the Wadden Sea was 171,2 +/- 81,9 ng/g (range: 28,3 – 418,6 ng/g) and therefore a little higher compared to 2014 (153,7 +/- 80,7 ng/g; range: 34,9 – 408,2 ng/g) but in the same dimension.

For **PCB** a prominent concentration peak was 2015 recognized at the Elbe, as seen the last time in 2011 and the years before. A second PCB peak occurred in Oystercatcher eggs from the Dollart. Here we found the highest levels in 2014. But on the other hand we saw 2015 the same trend as in 2014: the PCB concentrations equalise at the different locations of the Wadden Sea. In 2015 the average PCB level was 560,6 +/- 242,5 ng/g (range: 203,9 – 1205,0 ng/g) and so below the level of 2014 (645,8 +/- 281,5ng/g ; range: 194,2 – 1384,4 ng/g).

As in the years before in 2015 the clearly highest concentrations of **HCB** in oystercatcher eggs were measured at Delfzijl. But this time the values were obvious lower than in 2014 and in average “only” two to ten times higher compared to levels in Oystercatcher eggs from other areas. The amount of HCB in Common Terns eggs from most tested areas reached a similar level as these in Oystercatcher eggs at Delfzijl. Two further, but much smaller peaks were recorded in Oystercatcher eggs from the Dollart and river Elbe.

For **DDT** the highest concentrations in 2015 were found in Oystercatcher eggs from Trischen and the river Elbe but also concentration at the Dollart reached high levels. This was exact the same pattern as 2014.

In 2015 we see no longer the strong peak of **HCH** concentrations in eggs from the Halligen like 2013 and 2014. The geographical pattern of HCH was this year very similar to those from 2012 and the years before with a strong peak at Griend as well as some lower ones at Elbe and Trischen. But in general in all areas the **HCH** levels were in a similar scale with an average from 2,4+/- 2,2 ng/g (range: 0,0 – 9,9 ng/g).

For **Chlordanes** high values have been detected mainly in Oystercatcher eggs from the western areas like Balgzand, Julianapolder Delfzijl and Dollart. In general at all areas levels of Chlordanes were clearly higher in Oystercatcher eggs compared to those from Common Tern eggs.

In **Common Tern eggs** the main contamination area of **Hg**, **PCB**, **DDT**, **HCB** and **HCH** was located in 2015 clearly at the river Elbe. In general the contamination patterns were similar to those of the years before, but more distinct compared to 2014 showing mainly peak values at the river Elbe and high levels at Trischen, the areas which are influenced by the water of the Elbe.

In 2015 the **Hg** concentrations in the Common Tern eggs showed two groups of areas with rather equal levels. The first group had an average level of 300 ng/g fresh weight. The other areas showed an average level of 500 ng/g fresh weight and had peak values at Elbe and Delfzijl.

In the areas west of the river Elbe **DDT** concentrations in Common Tern eggs were 2015 rather similar showing a level of 50 ng/g fresh weight. Levels in the areas east were twice as big, whereas Common Tern eggs directly from the river Elbe reached sevenfold levels of DDT. For **PCB** we see a rather similar pattern as for DDT, but on a ten time higher level.

In 2015 the **HCB** concentration in Common Tern eggs were very similar at all sites with an average level of 7,0 +/- 3,1 ng/g fresh weight. They were clearly higher than HCB concentrations in Oystercatcher eggs, except these in Oystercatcher eggs from Delfzijl reaching equal amounts.

The measured **HCH** levels in Common Tern eggs ranged between 0,6 and 6,4 ng/g fresh weight with an average of 1,9 +/- 1,9 ng/g and a clear peak at the river Elbe.

Concentrations of **Chlordanes** recorded in 2015 in Common Tern eggs were in all areas rather low with an average of 0,3 +/- 0,2 ng/g and some small peaks at Schiermonnikoog and Halligen.

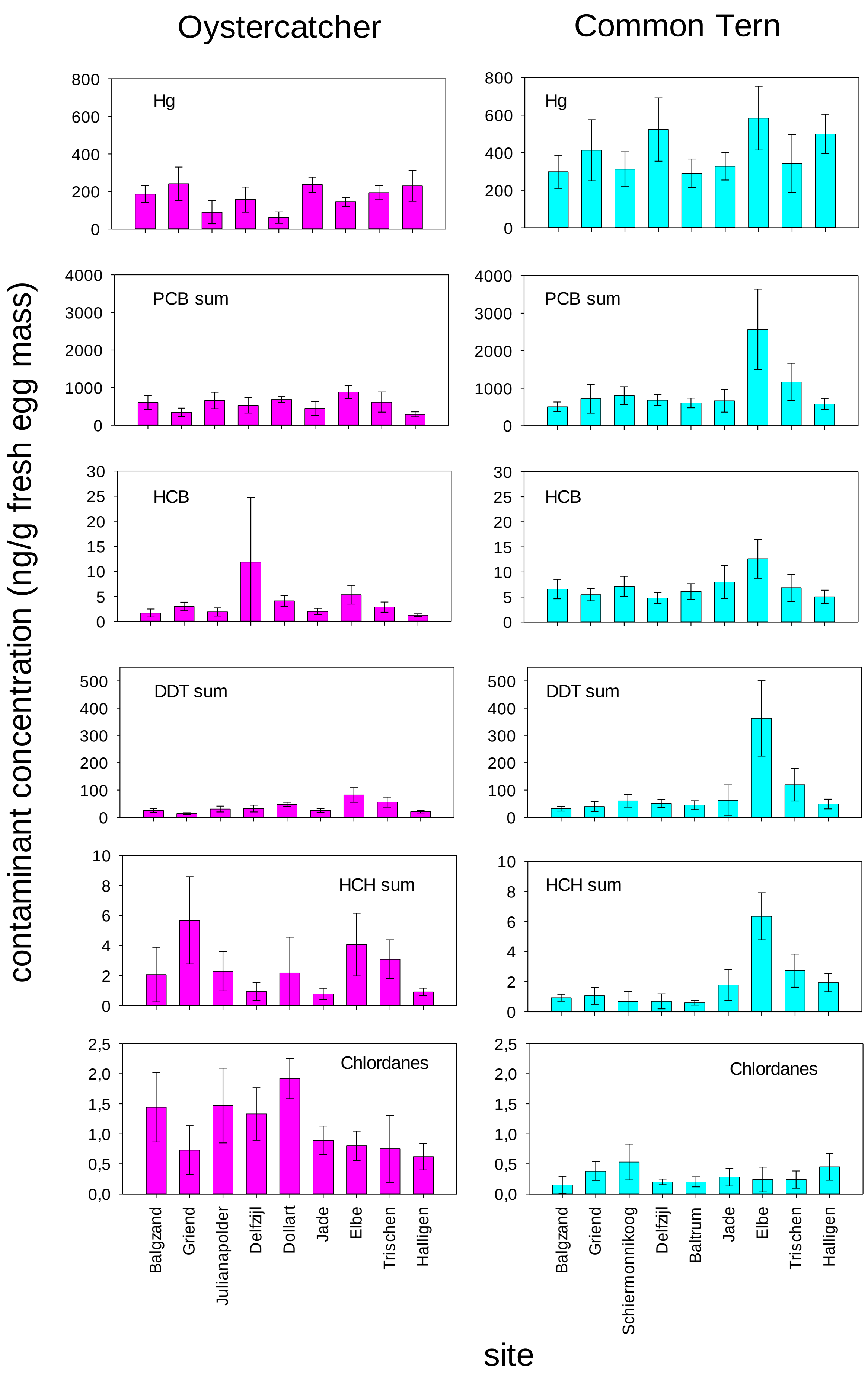

Fig. 5.1.1: Spatial patterns of pollutant concentrations in Oystercatcher and Common Tern eggs from the Wadden Sea in 2015 (means with standard deviations)

5.2 Annual variation in pollutant concentration in the period 2011-2015

Mean contamination values for the different substance groups in the period 2011-2015 are given in Figures 8.2.1-8.2.6 in the Appendix. A summarizing overview of short-term (2014-2015) and mid-term (2011-2015) temporal changes in the Dutch and German Wadden Sea are given in Tables 5.2.1 and 5.2.2.

Balgzand

Temporal Trends 2011-2015:

Oystercatcher	Significant **decrease** was detected in PCB, HCB, DDT and Chlordanes.
Common Tern	Significant **decrease** occurred in PCB, DDT, HCH and Chlordanes.

In 2015 significantly **lower** level of PCB, HCB and Chlordanes than in 2014 were found in Common Tern eggs. In Oystercatcher eggs concentration of HCB was **lower** in 2015 compared to 2014 whereas levels of Chlordanes **increased.**

Griend

Temporal Trends 2011-2015*:*

Oystercatcher	Significant **increase** was detected in HCH and a significant **decrease** in PCB, DDT and Chlordanes.
Common Tern	Significant **increase** was identified in levels of HCH.

Between 2014 and 2015 Chlordane concentrations **increased** in Oystercatcher eggs. In Common Tern eggs, the levels of HCH and Chlordanes **increased** in that period whereas levels of HCB **decreased**.

Julianapolder/Schiermonnikoog

Temporal Trends 2011-2015*:*

Oystercatcher	Significant **increase** in the concentration of HCH was identified at Julianapolder whereas levels of Hg and Chlordanes **decreased**.
Common Tern	Significant **decreases** in the concentrations of Chlordanes were detected at Schiermonnikoog.

In Oystercatcher eggs from 2015 sampled at Julianapolder, the concentrations of all measured chemicals **did not change** significantly compared to 2014. In Common Tern eggs from 2015 sampled at Schiermonnikoog, the level of Hg was significantly **higher** than in 2014.

Delfzijl

Temporal Trends 2011-2015*:*

Oystercatcher	The concentration of PCB, HCB, DDT and Chlordanes **decreased** significantly whereas concentrations of HCH **increased**.
Common Tern	In the period between 2011 and 2015 significant **decreases** in the concentrations of PCB, HCB and DDT occurred.

Between 2014 and 2015 HCB and DDT concentrations in Oystercatcher eggs **decreased**. In Common Tern eggs concentration of HCB was 2015 significantly **lower** compared to the year before whereas concentration of Hg **increased**.

Table 5.2.1: Overview over the development of selected pollutants in eggs of Oystercatcher and Common Tern in the Wadden Sea from 2011-2015, according to Spearman rank correlations.
-: significant decline, +: significant increase.

	Oystercatcher									Common Tern								
	Balgzand	Griend	Julianapolder	Delfzijl	Dollart	Jade	Hullen	Trischen	Halligen	Balgzand	Griend	Schiermonnikoog	Delfzijl	Baltrum	Jade	Neufelderkoog	Trischen	Halligen
Hg			-		-			-								-	-	+
PCB Summe	-	-		-	-	-			-	-			-		-			
HCB	-			-	-	-	-	-	-				-		-	-	-	
DDT Summe	-	-		-	-	-		-	-	-			-		-		-	
HCH Summe		+	+	+			-	-	-	-	+					-		+
Chlordan-Nonachlor-Summe	-	-	-	-	-	-	-	-	-	-		-				+		

Table 5.2.2: Overview over the development of selected pollutants in eggs of Oystercatcher and Common Tern in the Wadden Sea from 2014-2015, according to Mann-Whitney-U-tests. -: significant decline, +: significant increase.

	Oystercatcher									Common Tern								
	Balgzand	Griend	Julianapolder	Delfzijl	Dollart	Jade	Hullen	Trischen	Halligen	Balgzand	Griend	Schiermonnikoog	Delfzijl	Baltrum	Jade	Neufelderkoog	Trischen	Halligen
Hg					-	+		-	+			+	+	+	+	+		
PCB Summe					-		+	-	-	-								
HCB	-			-	-	-		-	-	-	-		-	-				-
DDT Summe				-	-			-	-	-								-
HCH Summe						-		-	-		+					+	+	-
Chlordan-Nonachlor-Summe	+	+			-	-	-	-	-		+				-	-	-	

6. General Assessment

6.1 Spatial Trends

The concentrations of the mentioned substances in **Oystercatcher** eggs showed in 2015 only small geographical differences. Conspicuous were, as in the years before, the HCB concentrations at Delfzijl, which were two to nine times higher compared to other sites in the Wadden Sea. In Oystercatcher eggs highest levels of PCB and DDT were detected at the River Elbe whereas HCH reached highest levels at Griend. Compared to 2014 the measured concentrations were slightly lower in case of

PCB, DDT, HCH and Chlordanes, but tended to be higher in case of Hg. In case of HCB the measured concentrations were up to three times lower compared with the year before, also at Delfzijl.

In the **Common Tern**, clearly prominent concentration peaks of Hg, PCB, DDT, HCB and HCH were found 2015 again at the Elbe estuary. Consequently, a continuous decrease of pollution was recorded with increasing distance from the Elbe estuary which is in accordance to the observations from previous years. So we found the second highest levels mostly at Trischen, as the area is influenced most by the waters of the river Elbe. But we found high HCB concentrations in 2015 also in the western areas. Different to 2014 there were strikingly increased geographical differences of the Hg concentrations in Common Tern eggs, but without a visible pattern. High Hg concentrations were observed, beside the river Elbe, at Griend, Delfzijl and Halligen. The average level of 400 ng/g Hg over all investigated areas of the Wadden Sea was clearly higher than in 2014. In case of HCB we saw a lesser influence of the river Elbe compared to the other contaminants: The concentration showed only small geographical differences and tended to align in Common Tern eggs at a level of ca. 7 ng/g fresh weight which is clearly lower compared to 2014 - but clearly higher in comparison with the Oystercatcher eggs. In case of Hg and PCB the concentrations in Common Tern eggs tended to be higher in 2015 than in 2014 whereas in case of DDT and HCH they were rather similar.

In general, the species-specific spatial contamination patterns in 2015 remained similar to those recorded in 2014 and the years before: The contamination pattern of the Common Tern again showed clear concentration peaks at the river Elbe. In contrast the contamination pattern of the Oystercatcher was inconsistent, showing different geographical peaks for each component. The species-specific patterns may have been influenced by differences in the feeding ecology, with the Oystercatcher possibly foraging to a higher degree in terrestrial habitats at some sites. This might explain why in particular at the river Elbe, no maximum concentrations have been found in the Oystercatcher but in the Common Tern. Furthermore, for the benthic feeding Oystercatcher, contaminants bound to sediment particles which might have been transported previously, are probably more important than for the pelagic feeding Common Tern. In addition, the partly whole-year presence of the Oystercatcher in the Wadden Sea might have affected the contamination patterns recorded. In general, the data underline the importance of the large rivers Elbe and Ems for the influx of several contaminants into the Wadden Sea. For Hg, PCB, HCB and DDT, contamination levels tended to be higher in the Common Tern than those in the Oystercatcher (except for HCB at Delfzijl), reflecting the higher trophic level of the piscivorous Common Tern with an even more effective bioaccumulation of pollutants. However, at most study sites Chlordane concentrations were clearly higher in Oystercatcher eggs than in Common Tern eggs.

The mentioned concentration peak of HCB in Oystercatcher eggs from Delfzijl could be seen since many years and may be caused by contaminated water and sediment in the Sea Harbour Channel in Delfzijl (Eggens & Bakker 2001). In the period 2008-2012 (see TMAP reports 2011 and 2012) increasing concentrations were evident after the HCB concentration had decreased until 2000 (Eggens & Bakker 2001). After an increase in 2014 the concentrations in 2015 were clearly lower compared to the previous year and reached the level of 2008/2009.

In the past the influx of Hg into the Wadden Sea took place over the rivers. Most important was the river Elbe. In the last years we see a reduction impact of rivers and in 2015 for both species a distinct discharge of Hg into the Wadden Sea was not visible. The Hg levels tended to be higher in the Common Tern than those in the Oystercatcher, reflecting the higher trophic level. But there was no geographical difference in the eggs Hg concentrations and for both species there was an established level of Hg in all investigated areas of the Wadden Sea. The reason for this trend may be the success of the environmental constraints of the river waters on the one hand and the still high Hg influx over the atmosphere on the other hand. The most important process for the man made Hg emission into the atmosphere is coal burning. Compared to the year before the Hg concentrations in Common Tern were 2015 higher and at all areas still above the Ecological Quality Objectives (EcoQOs) of 160 ng/g Hg (e.g. Dittmann et al. 2012).

6.2 Temporal trends

Although for both species during the **five-year-period 2011-2014** more decreasing than increasing contamination levels of the measured substances at the different study sites could be seen, there was in many cases no clear picture of the resulting temporal trend, and so the results were not easy to interpret.

In **Oystercatcher** eggs decreasing concentrations were detected in case of Hg at three of the nine sampled sites as well as in case of PCB at six and in case of DDT and HCB at seven, respectively. Remarkable were the concentrations of Chlordane, which decreased at all investigated areas. In total we see 35 decreases and most of them were detected at Trischen, Dollart and Halligen (in each case five).
In case of HCH increases were seen at three of the nine sampled sites, mainly at western areas, but HCH decreased also at three areas in the eastern part of the Wadden Sea. In total we see only three increases in Oystercatcher eggs in 2015. In general in most cases the measured de- or increases were only small although constant (see figures at 8.2).

In the **Common Tern** eggs we detected significant in- and decreases in the period during 2011-2015 too. We see a decrease of DDT and HCB concentrations at four of nine study sites each, in the PCB concentrations at three as well as in the Hg, HCH and Chlordane concentrations at each two sites respectively. In total we found 17 significant decreased substance levels in Common Tern eggs and most of them were detected at Balgzand (four) as well as at Delfzijl, Oldeoog, Neufelderkoog and Trischen (in each case three). Increases were found in case of HCH at two, as well as in case of Hg and Chlordanes at one site each. In total we found four significant increased substance levels in Common Tern eggs and most of them at Hallig Hooge (two).

When **comparing the year 2015 with 2014** we recorded clearly more contamination decreases (23) as increases (6) in **Oystercatcher** eggs (Tab. 5.2.2.). But there was no visible pattern in the data. De- and increases occurred at different places of the Wadden Sea and in different chemical groups. Most decreases occurred at Trischen (6) as well as at Dollart and Halligen (five each). Two points were remarkable: First the concentrations of Chlordanes increased at the two western sites but decreased in the whole eastern part between Dollart and Halligen, and second TEQs in the Oystercatcher eggs increased at Trischen whereas the total PCB-concentration decreased there. TEQs increased also at Balgzand and Griend. The Hg concentrations showed a mixed picture, with decreases at two sites as well as increases at two other sites. In contrast the trend of the HCB concentrations was rather uniform, which decreased at six of the nine investigated sites between 2014 and 2015.

In **Common Tern** eggs, too, more contamination decreases (12) than increases (9) were detected (Tab. 5.2.2.): rather consistently the HCB concentrations decreased at five of the nine study sites as well as the Hg increased at five sites. Most chemical groups decreased at Balgzand and Halligen (three each). Most increases were due to rising concentrations of HCH at three sites. Also the level of TEQs increased at four places in the Wadden Sea whereas a decrease occurred only at one site.

6.3 Summarized Assessment

Summarizing, the results from 2015 indicate similar species-specific spatial contamination patterns as in the previous years. Whereas the Elbe is again the most prominent site of contamination in the Common Tern, in the case of Oystercatcher particularly high concentrations of HCB have been found at Delfzijl. In Oystercatcher eggs, the spatial contamination peaks as well as the total burden of environmental chemicals were less than in the Common Tern eggs.
When comparing the year 2015 with the previous one both species showed a higher Hg burden in their eggs. In contrast the HCB concentrations were lower in 2015 after a steadily increase in the previous years (Becker et al 2001, Mattig et al. 2014). But in general the concentrations of the measured environmental chemicals were 2015 nearly in the same dimension than 2014. Our data show that the

contamination levels in the eggs of the two species remained firm at the higher level after a constant increase until 2011/2012. Even with the data from 2015 the question if the contamination level of the environmental chemicals showed fluctuations around established levels in birds (cf. Becker & Dittmann 2009) could not finally be answered. This is also of interest on the background of the Ecological Quality Objectives (EcoQOs) defined by OSPAR in recent years for coastal bird eggs from the North Sea area (Dittmann et al. 2012). For the Common Tern eggs the limit values of Hg (160 ng/g), PCB (20 ng/g), HCB (2 ng/g) and DDT (10 ng/g) were exceeded in 2015 at all investigated areas. For the Oystercatcher eggs the limit values of Hg (100 ng/g) were undercut only at two places as well as in case of HCH and HCB at three areas each. However the results of PCB and DDT exceeded the EcoQO levels at all places. These results underline that the target aims defined by OSPAR nowhere near fulfilled.

7. Literature

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This report was compiled by Frank R. Mattig, Ursula Pijanowska and Peter Schupp.

Wilhelmshaven, 29 February 2016

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(Prof. Dr. Peter Schupp)

8. Appendix

8.1 Concentrations of selected contaminants in eggs of Oystercatcher and Common Tern at different sites of the Dutch Wadden Sea 2015

Table 8.1.1: Concentrations of chemicals in Oystercatcher and Common Tern eggs sampled in The Netherlands in 2015. Mean concentrations in ng/g (fresh mass of egg content), standard deviations and number of samples are presented.

	Balgzand			Griend			Julianapolder			Delfzijl		
Oystercatcher	**(N=10)**			**(N=10)**			**(N=10)**			**(N=10)**		
Hg	186,1	±	45,2	241,6	±	88,5	89,8	±	61,9	157,3	±	66,9
6 PCB (law)	264,5	±	92,9	138,3	±	54,3	285,8	±	104,6	225,0	±	94,2
PCB sum	603,4	±	185,5	343,5	±	110,4	656,0	±	218,5	527,1	±	204,6
HCB	1,7	±	0,8	3,0	±	0,9	1,9	±	0,8	11,8	±	12,9
ppDDE	21,8	±	6,1	11,0	±	3,1	26,9	±	9,8	28,0	±	12,0
ppDDT	0,4	±	0,7	0,0	±	0,0	0,7	±	1,6	1,1	±	1,5
ppDDD	2,9	±	0,0	2,8	±	0,0	2,9	±	0,1	3,0	±	0,2
DDT sum	25,1	±	6,5	13,7	±	3,1	30,4	±	10,8	32,0	±	12,5
alpha-HCH	0,1	±	0,1	0,0	±	0,0	0,1	±	0,3	0,0	±	0,0
beta-HCH	2,0	±	1,8	5,6	±	2,9	2,2	±	1,4	0,9	±	0,6
gamma-HCH	0,0	±	0,0	0,0	±	0,0	0,0	±	0,0	0,0	±	0,0
HCH sum	2,1	±	1,8	5,7	±	2,9	2,3	±	1,3	0,9	±	0,6
Chlordane sum	1,4	±	0,6	0,7	±	0,4	1,5	±	0,6	1,3	±	0,4

	Balgzand			Griend			Schiermonnikoog			Delfzijl		
Common Tern	**(N=10)**			**(N=10)**			**(N=10)**			**(N=10)**		
Hg	298,4	±	88,2	412,9	±	162,6	311,9	±	92,7	523,2	±	168,9
6 PCB (law)	227,1	±	56,6	321,9	±	196,4	349,4	±	122,0	298,7	±	71,0
PCB sum	507,9	±	126,0	719,0	±	382,9	802,0	±	241,1	683,7	±	144,5
HCB	6,6	±	2,0	5,5	±	1,2	7,2	±	2,0	4,8	±	1,1
ppDDE	28,7	±	8,7	36,4	±	18,1	56,4	±	23,1	47,3	±	13,6
ppDDT	0,0	±	0,0	0,0	±	0,0	0,5	±	1,2	0,0	±	0,0
ppDDD	2,9	±	0,2	2,8	±	0,1	3,3	±	0,6	3,9	±	2,0
DDT sum	31,5	±	8,7	39,2	±	18,2	60,3	±	23,0	51,1	±	15,3
alpha-HCH	0,1	±	0,1	0,0	±	0,1	0,1	±	0,1	0,0	±	0,0
beta-HCH	0,8	±	0,2	1,0	±	0,6	0,4	±	0,4	0,7	±	0,5
gamma-HCH	0,0	±	0,0	0,0	±	0,1	0,3	±	0,4	0,0	±	0,0
HCH sum	0,9	±	0,2	1,1	±	0,6	0,7	±	0,7	0,7	±	0,5
Chlordane sum	0,2	±	0,1	0,4	±	0,2	0,5	±	0,3	0,2	±	0,0

8.2 Temporal trends of pollutant concentrations at different sites during 2011-2015

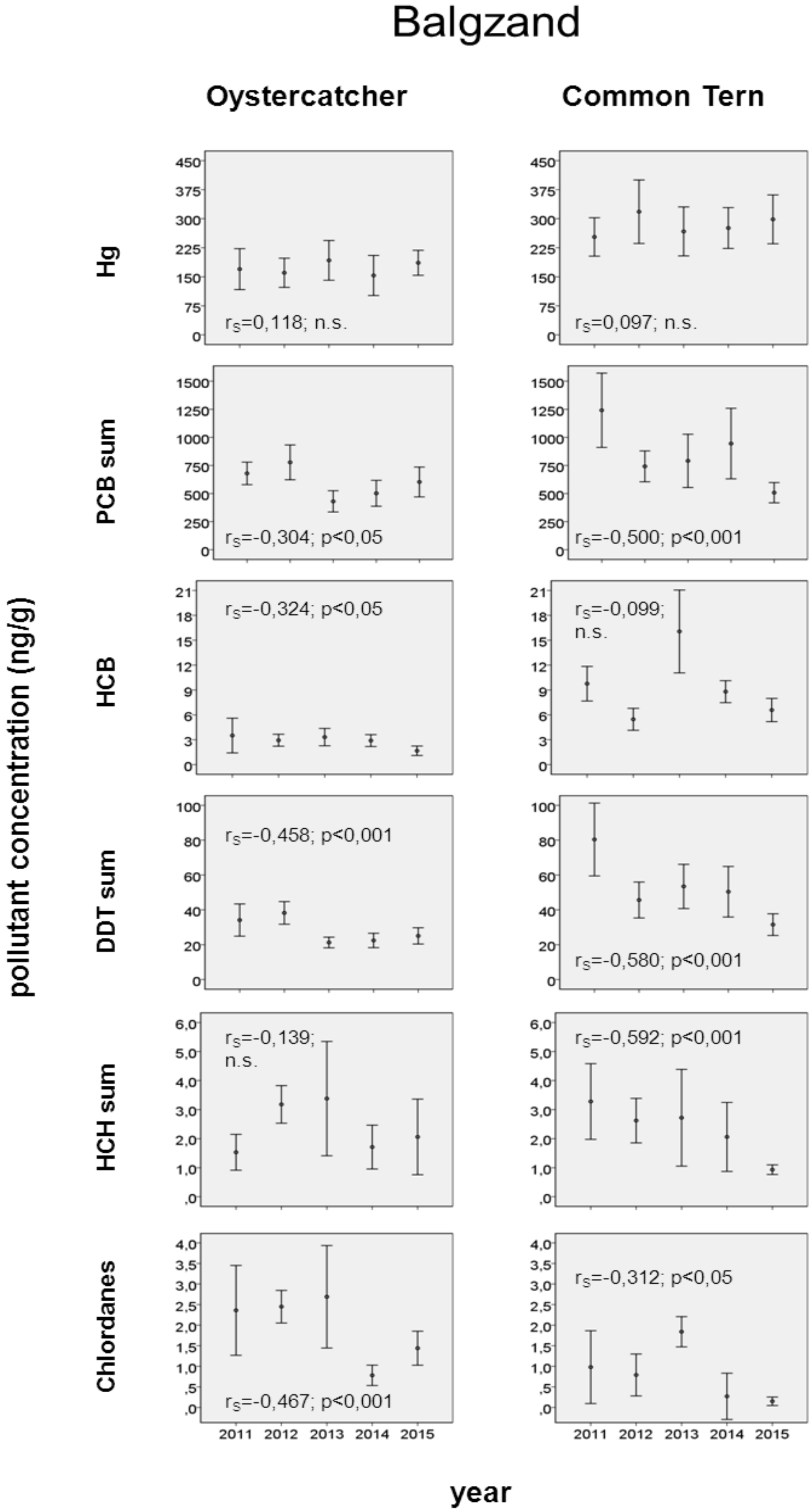

Fig. 8.2.1: Temporal development of pollutant concentrations in Oystercatcher and Common Tern eggs from Balgzand, NL, in the period 2011-2015. Arithmetic means are given with the 95% confidence interval.

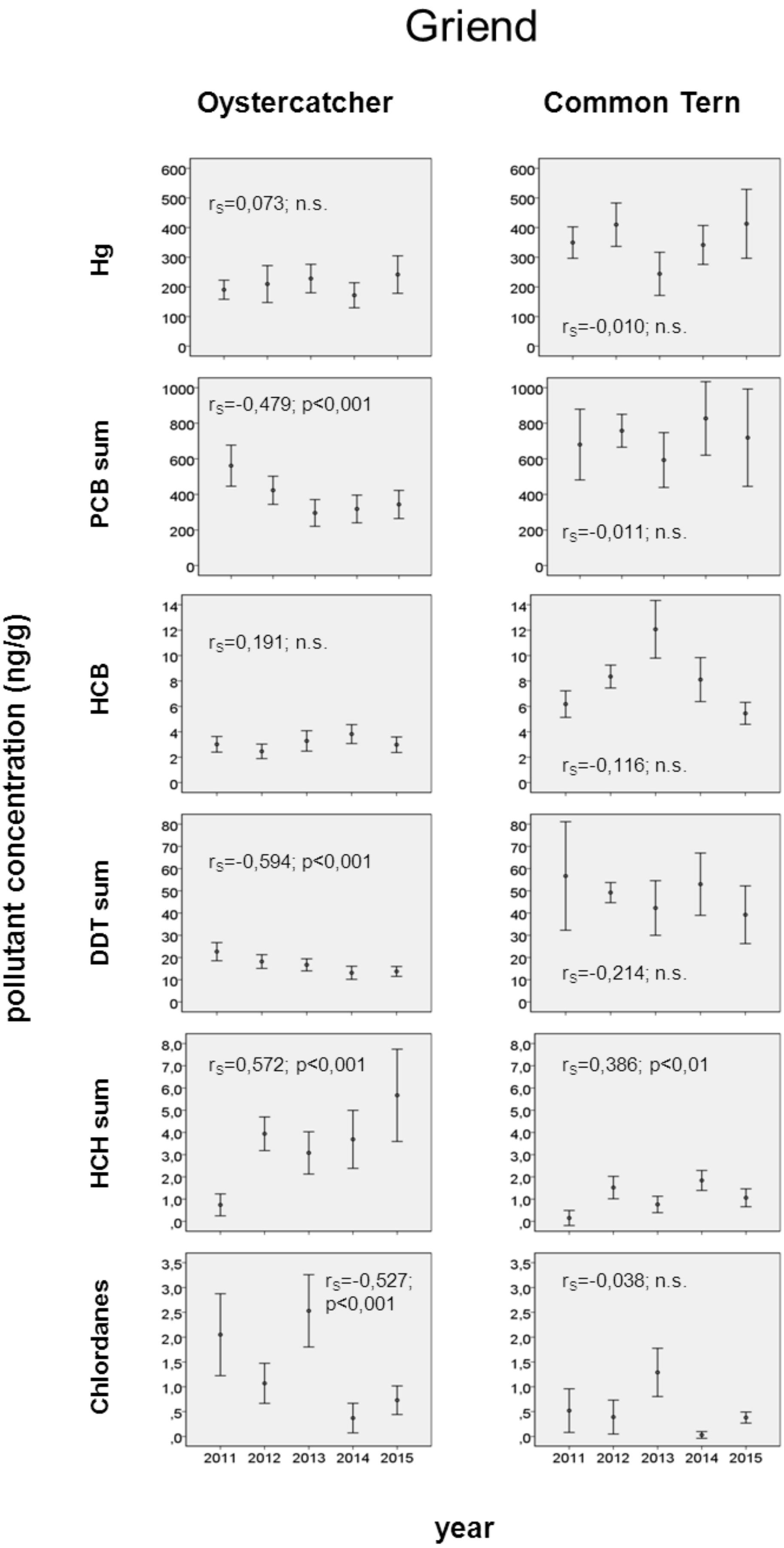

Fig. 8.2.2: Temporal development of pollutant concentrations in Oystercatcher and Common Tern eggs from Griend, NL, in the period 2011-2015. Arithmetic means are given with the 95% confidence interval.

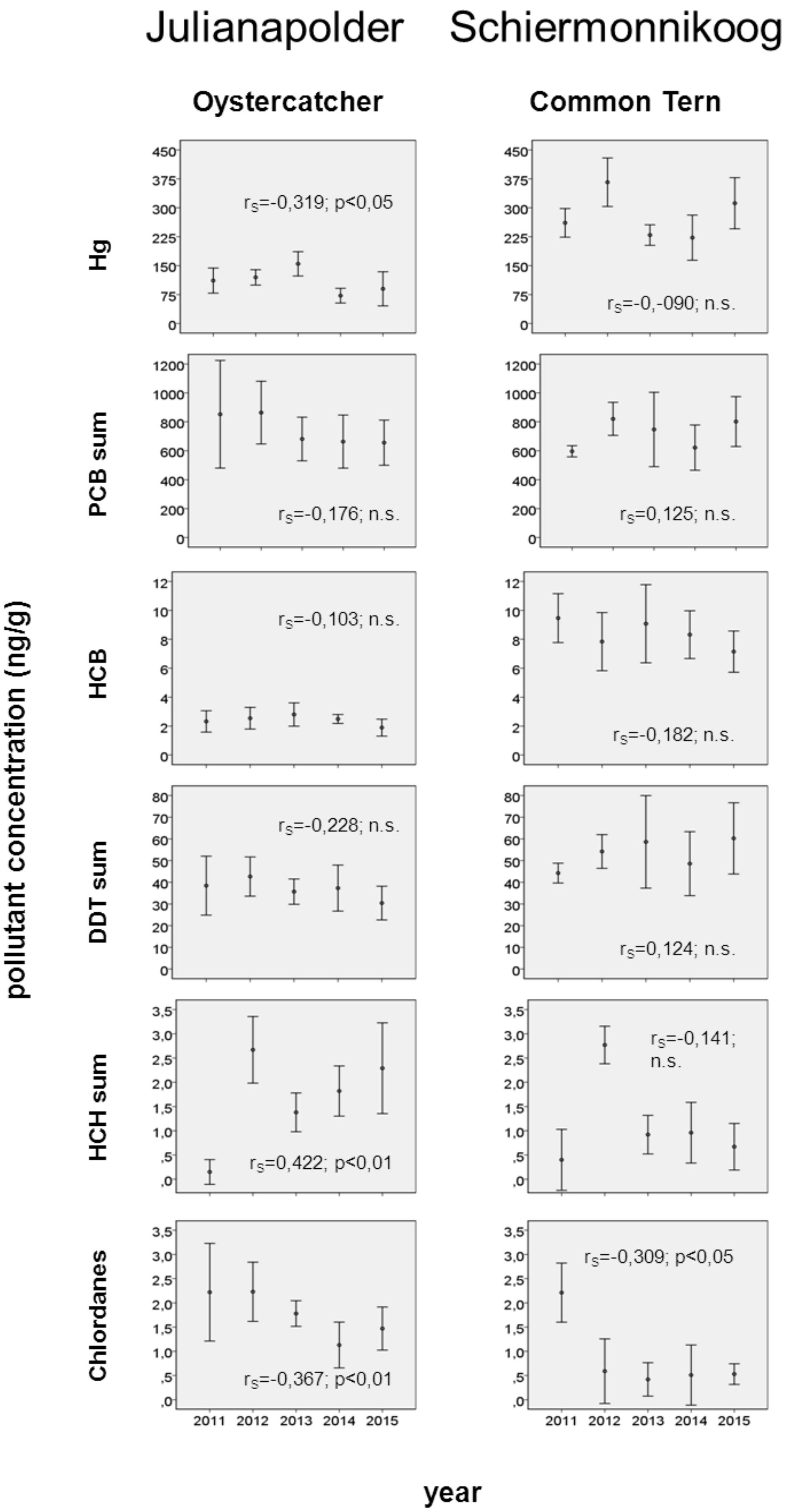

Fig. 8.2.3: Temporal development of pollutant concentrations in Oystercatcher eggs from Julianapolder and in Common Tern eggs from Schiermonnikoog, NL, in the period 2011-2015. Arithmetic means are given with the 95% confidence interval.

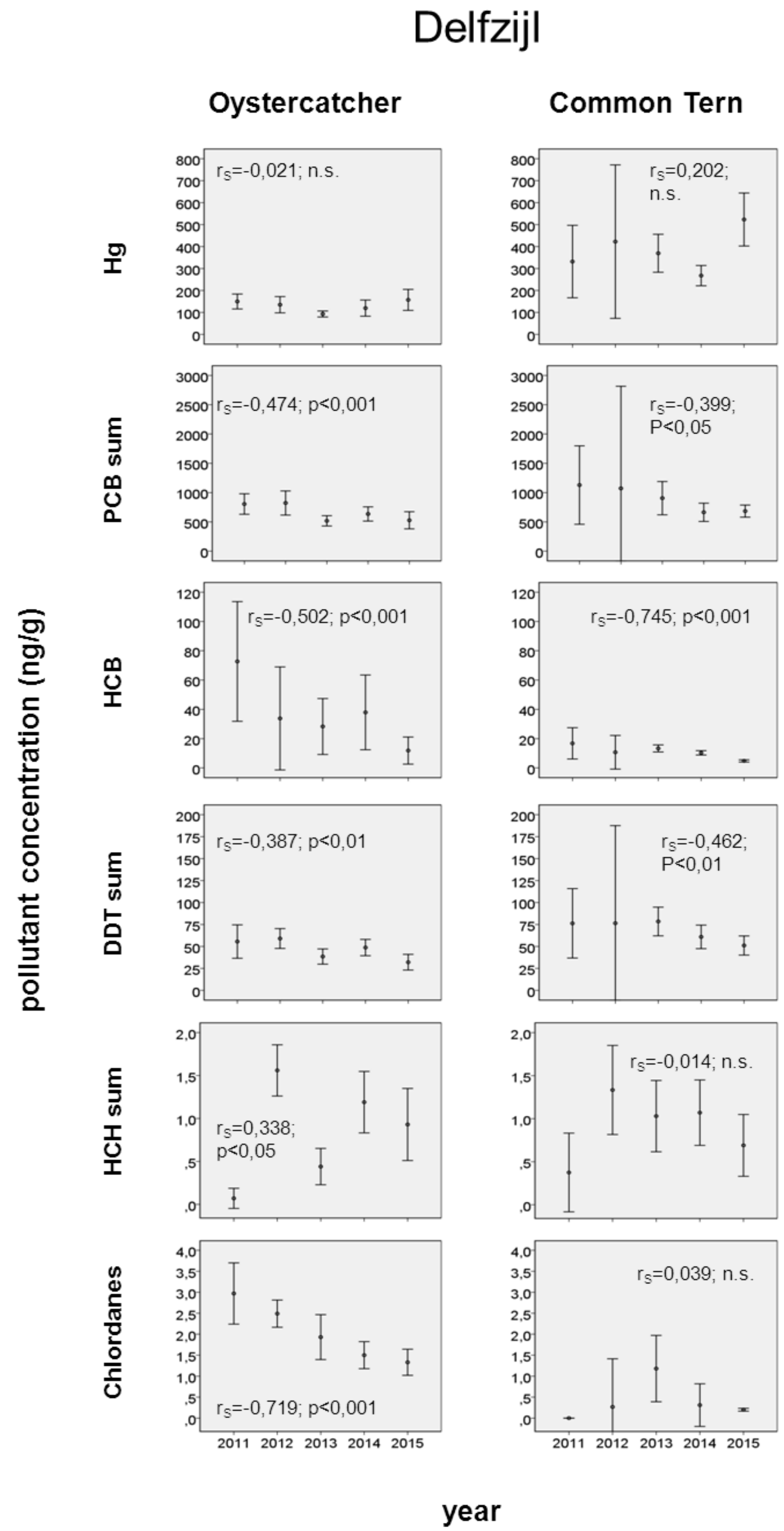

Fig. 8.2.4: Temporal development of pollutant concentrations in Oystercatcher and Common Tern eggs from Delfzijl, NL, in the period 2011-2015. Arithmetic means are given with the 95% confidence interval.