Brief reports · Tiedonantoja

Residues of DDT and PCBs in the eggs of the Herring Gull *Larus argentatus* in the archipelago of southwestern Finland

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As DDT and PCBs have deleterious effects on the reproductive success of birds and also on chick survival, we measured DDT and PCB residues in eggs of Herring Gulls in the archipelago of southwestern Finland. The samples were taken in Kustavi and Sauvo in 1978. The distance between the colonies was about 100 km (Fig. 1). We also examined whether the laying sequence had an effect on the levels of chlorinated hydrocarbons.

The eggs were collected at the beginning of incubation and were kept frozen at −18°C. For the analysis, the eggs were thawed and homogenized with a macerator and samples were weighed out (2–5 g). The samples were then homogenized again in a mortar with granular quartz, mixed with a fourfold amount of anhydrous sodium sulphate, dried overnight at room temperature and Soxhlet-extracted with a mixture of hexane, acetone, diethyl ether and petroleum ether (2.5 : 7.5 : 1 : 9 w/w) (Hattula 1973). The extracted fat was weighed and purified by TLC on Silica Gel (Linko et al. 1974). The analyses were conducted on a Varian gas chromatograph, Model 2440, equipped with two ^{3}H-electron capture detectors. The packing material in the column was 6 % (w/w) GE SF-96 on Chromosorb W. The carrier gas was nitrogen (30 ml/min). The standard compounds were p,p'-DDE, p,p'-DDD, p,p'-DDT and Clophen A 60 (PCB). The sum of DDE, DDD and DDT is referred to in the text as sDDT. The PCBs were quantified by summing the five highest peaks that did not overlap with the pesticide peaks and taking their mean value. The recovery percentages for p,p'-DDE, p,p'-DDD, p,p'-DDT and PCBs (Clophen A 60) were 84±8, 95±4, 86±4 and 94±2.

In the eggs collected in Kustavi the levels of sDDT and PCB residues were significantly lower than in the eggs from Sauvo (Table 1). The fact that in Kustavi the lipid content of the eggs was higher than in Sauvo makes the difference even more remarkable. The proportion of DDE in sDDT was almost the same in both colonies, in Kustavi 96.3 % and in Sauvo 97.0 %.

The differences in the levels of sDDT and PCB residues between Kustavi and Sauvo might be due to the female gulls using different wintering areas or different food during the wintering or breeding season. However, the Herring Gulls from SW Finland winter mainly in the southern Baltic Sea and no differences have been found between the individuals of different colonies in the Finnish southwestern archipelago (Kilpi & Saurola 1984). It is possible that the female gulls use different food in the breeding area, for some gulls take their food at dumps, where the DDT and PCB levels in the edible matter are low, while other gulls feed mainly on fish and may ingest more chlorinated hydrocarbons. This has not been studied, however.

The levels of DDE and PCB residues in the eggs from Kustavi and Sauvo are fairly similar to the levels observed in the southern Baltic Sea area (Eggers et al. 1977). In the North Sea the levels are much lower (Johansen 1978, Jørgensen & Kraul 1974), which is evidence of the pollution of the Baltic Sea.

As the laying sequence of the eggs could be determined, it was possible to examine its effect on the levels of sDDT and PCB residues (Figs. 2 and 3).

If we consider the egg material as a whole, the levels of sDDT and PCBs were in most cases lower in the second egg than in the first one and the lipid content changed in the same way. The residue levels in the third eggs had no noticeable trend compared with the first or second ones. The weights of the eggs were also measured and the amounts of sDDT and PCBs in every egg were calculated separately. This did not, however, change the effect of the laying sequence. The highest amounts of sDDT and PCBs recorded in an egg in Kustavi were 1.06 mg and 3.60 mg and in Sauvo 1.23 mg and 3.78 mg, respectively. The combined data were tested with the Kruskal–Wallis test (Table 2).

In this study the laying sequence had no statistically significant effect on the levels of sDDT and PCBs. The sample

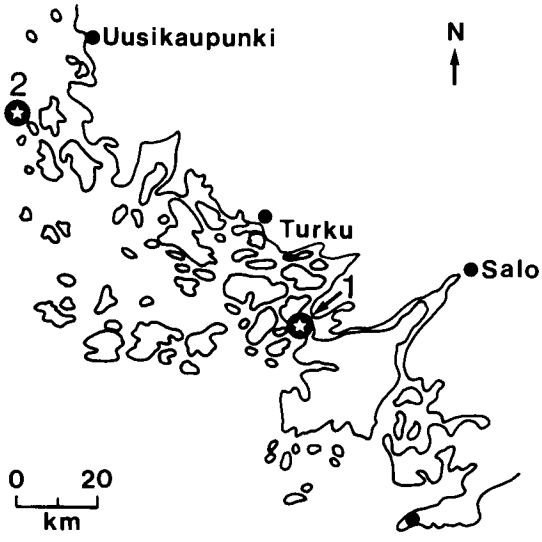

Fig. 1. The sampling areas: 1. Sauvo, Peimar, Bådan; 2. Kustavi, Porkankari.

Table 1. The levels of sDDT and PCB residues in the eggs of Herring Gulls in Kustavi and in Sauvo (mg/kg) and the statistical significance of the differences (Kruskal–Wallis test) (– not calculated; ns not significant; o $P < 0.1$; * $P < 0.05$; ** $P < 0.01$).

	Kustavi	Sauvo	Signif.
Eggs (N)	9	20	–
Lipid content (%)	9.1 ± 2.7	7.5 ± 1.9	o
Lipid			
sDDT	45.6 ± 15.5	97.3 ± 43.6	**
DDE	43.6 ± 15.4	93.9 ± 43.0	**
DDD	0.8 ± 0.5	0.7 ± 1.9	ns
DDT	0.9 ± 0.3	2.6 ± 3.6	*
PCB	130.8± 96.3	260.0 ± 137.0	*
Fresh			
sDDT	4.3 ± 2.7	7.0 ± 3.1	*
DDE	4.1 ± 2.6	6.8 ± 3.2	*
DDD	0.1 ± 0.04	0.1 ± 0.1	**
DDT	0.2 ± 0.2	0.2 ± 0.2	ns
PCB	12.6 ± 11.8	18.1 ± 7.7	o

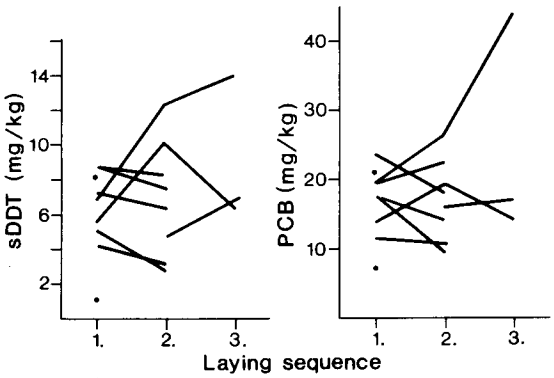

Fig. 2. The levels of sDDT and PCB residues in the eggs of Herring Gulls (mg/kg of fresh weight) as a function of the laying sequence in Sauvo.

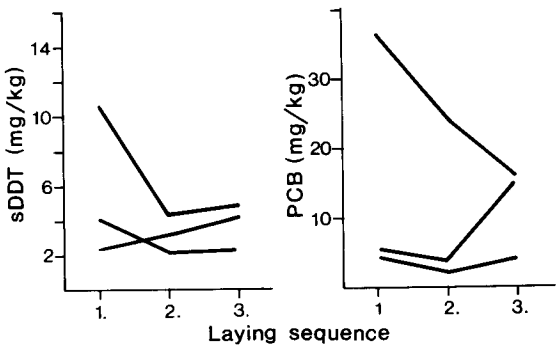

Fig. 3. The levels of sDDT and PCB residues in the eggs of Herring Gulls (mg/kg of fresh weight) as a function of the laying sequence in Kustavi.

was, however, very small. When studying the eggs of European Sparrowhawks *Accipiter nisus*, Newton and Bogan (1978) also found that the organochlorine concentrations did not differ significantly according to the laying sequence. According to Johansen (1978), however, in Great Black-backed Gulls *Larus marinus* the levels of DDE and PCBs are highest in the second egg. The second egg of Great Crested Grebes *Podiceps cristatus* and Little Grebes *Tachybaptus ruficollis* also has higher levels of DDE and PCBs than the first one (Alberto & Nadal 1981). Nisbet (1982) reported that in the third eggs of Common Terns *Sterna hirundo* organochlorine concentrations are generally higher by about 20 % than in the first eggs. He suggested that the difference may be related to changes in the lipid balance of female Common Terns during the egg-laying period. Prior to egg-laying female Common Terns accumulate substantial weight-reserves, but during the egg-laying period their food intake is reduced and the reserves are rapidly depleted. It is probable that the effect of the laying sequence on the concentrations of DDT and PCBs varies with the species and the feeding habits during egg-laying.

Although the eggs of Herring Gulls in the archipelago of SW Finland have relatively high sDDT and PCB levels, no reproduction problems have been observed.

Table 2. The levels of sDDT and PCB residues in the eggs of Herring Gulls (mg/kg) according to the laying sequence and the statistical significance of the differences (Kruskal–Wallis test). The data from Kustavi and Sauvo combined. The symbols as in Table 1.

	I egg	II egg	III egg	Signif.
Eggs (N)	12	11	6	–
Lipid content (%)	8.5 ± 2.5	7.2 ± 2.3	8.4 ± 1.3	ns
Lipid				
sDDT	73.2 ± 33.1	91.1 ± 54.4	78.7 ± 47.3	ns
DDE	69.8 ± 33.6	88.8 ± 52.1	75.0 ± 47.0	ns
DDD	1.1 ± 2.4	0.3 ± 0.4	0.6 ± 0.7	ns
DDT	2.4 ± 3.0	1.9 ± 3.8	2.1 ± 2.1	ns
PCB	193.7 ± 81.8	247.0 ± 181.7	222.4 ± 151.1	ns
Fresh				
sDDT	6.2 ± 2.9	6.0 ± 3.4	6.5 ± 4.1	ns
DDE	5.9 ± 2.9	5.9 ± 3.4	6.3 ± 4.1	ns
DDD	0.1 ± 0.2	0.02 ± 0.03	0.1 ± 0.1	ns
DDT	0.2 ± 0.2	0.1 ± 0.1	0.3 ± 0.3	o
PCB	16.5 ± 5.0	15.2 ± 8.0	18.3 ± 13.2	ns

Acknowledgements. We are grateful to Miss Terttu Laurikainen for drawing the figures. The analyses were financed by the Turku University Foundation.

Selostus: **Harmaalokin munien DDT- ja PCB-pitoisuuksista Saaristomerellä**

Saaristomeren harmaalokkien munien DDT- ja PCB-pitoisuuksia analysoitiin Kustavin ja Sauvon alueilta kerätyistä näytteistä. Kustavista kerätyissä munissa sDDT- ja PCB-pitoisuudet olivat merkittävästi pienempiä kuin Sauvon aineistossa. Kustavissa sDDT:tä oli keskimäärin 4.3 mg/kg ja PCB-yhdisteitä 12.6 mg/kg ja Sauvossa sDDT:tä 7.0 mg/kg ja PCB-yhdisteitä 18.1 mg/kg tuorepainoa kohti laskettuna. Eron tekee vielä merkittävämmäksi se, että Kustavissa munien rasvapitoisuus oli korkeampi kuin Sauvossa. Syynä eroon saattaa olla emojen erilainen ravinto. Tutkimustuloksia tästä ei kuitenkaan ole.

Koska munat oli identifioitu munimisjärjestyksen mukaan, oli mahdollista seurata munimisjärjestyksen vaikutusta sDDT- ja PCB-pitoisuuksiin. Toisessa munassa oli useimmissa tapauksissa vähemmän sDDT:tä ja PCB-yhdisteitä kuin ensimmäisessä. Erolla ei kuitenkaan ollut tilastollista merkitystä.

References

Alberto, L.J. & Nadal, J. 1981: Organochlorine residues in eggs of 10 species of birds of the Ebro delta, Terragana, Spain. – Publ. Dep. Zool. 6:73–84.

Eggers, H., Berling, R., Riemer, F. & Grisk, A. 1977: Über den Gehalt von DDT, DDT-Metaboliten und polychlorierten Biphenylen in Eiern der Silbermöwe Larus argentatus. – Beitr. Vogelkd. 23:1–8.

Hattula, M.-L. 1973: Analysis of DDT- and PCB-type compounds at low level in fish with reference to pike, perch and bream in Lake Päijänne. – Thesis, Inst. of Food Chemistry and Technology, University of Helsinki, EKT ser. 301.

Johansen, O. 1978: DDE, PCB og Hg in egg av Svartbak og gråmåke fra kolonier i Møre og Romsdal. – Stavanger Museums Årbok 1978:67–72.

Jørgensen, O.H. & Kraul, I. 1974: Eggshell parameters, and residues of PCB and DDE in eggs from Danish Herring Gull Larus a. argentatus. – Ornis Scand. 5:173–179.
Kilpi, M. & Saurola, P. 1984: Migration and wintering strategies of juvenile and adult Larus marinus, L. argentatus and L. fuscus from Finland. – Ornis Fennica 61:1–8.
Linko, R., Kaitaranta, J., Rantamäki, P. & Eronen, L. 1974: Occurrence of DDT and PCB compounds in Baltic Herring and Pike from the Turku Archipelago. – Environm. Poll. 7:193–207.
Newton, I. & Bogan, J. 1978: The role of different organochlorine compounds in the breeding of British Sparrowhawks. – J. Appl. Ecol. 15:105–116.
Nisbet, I.C.T. 1982: Eggshell characteristics and organochlorine residues in Common Terns: variation with egg sequence. – Colonial Waterbirds 5:139–143.

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Intensive night migration of Long-tailed Tits *Aegithalos caudatus*

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On 3 April 1983 very intense migration of Long-tailed Tits was observed after midnight at the Port of Mäntyluoto (61° 05'N, 21°30'E) on the west coast of Finland. The call of the species was heard from the night sky about 400 times in 80 minutes. The tits were moving northwards, following the alder woods that bordered the shore. The migration was in full progress when the observation began and was still intensive when the observers left. The night was quite warm (+3°C) and calm, but very foggy. Only a few birds were seen in the artificial lights of the harbour.

The Long-tailed Tit breeds in southern Finland southwards of the 65th latitude (Hyytiä et al. 1983). Large fluctuations in the size of the breeding population are characteristic of this species. The breeding success of the summer is seen in the numbers of birds leaving the country in the autumn. In contrast other invading passerines, these tits have a very stable schedule. On the west coast of Finland, the first Long-tailed Tits are seen in late September and the peak is reached in late October. The last tits are seen leaving in mid November and some small flocks overwinter in Finland.

In autumn 1982 the Long-tailed Tit was scarce: only 11 flocks were reported from the county of Satakunta (Lampolahti & Virtanen 1983). Only three flocks were seen at Säppi bird station 15 km south of Mäntyluoto (Eriksson & Lilja 1983), where hundreds of Long-tailed Tits are seen in many autumns. The winter occurrence was normal: 8 flocks were observed on the Yyteri Peninsula, where Mäntyluoto is located (records of the Ornithological Society of Pori). Exceptionally many observations of Long-tailed Tits were made on the coast of Satakunta in the first half of April 1983.

The survival of the tits that leave Finland has been supposed to be very low (v. Haartman et al. 1963–72). There are only a few obsevations of Long-tailed Tits returning over the sea in the spring. The present observation suggests that the survival may be higher than so far believed. If the return occurs along the coast during a few nights in early April, it will easily pass unnoticed, while ornithologists are inland listening to owls or sleeping. The night migration of Long-tailed Tits has been unknown phenomenon.

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Selostus: **Voimakasta pyrstötiaisen yömuuttoa Mäntyluodossa**

Mäntyluodon satamassa havaittiin 3.4.1983 puolenyön jälkeen voimakasta pyrstötiaismuuttoa. Lajin kutsuääntä kuultiin yötaivaalta noin 400 kertaa 80 minuutin aikana. Tiaiset liikkuivat pohjoista kohden rantojen tervaleppämetsiköiden suuntaisesti. Havainnoinnin alkaessa muutto oli jo täydessä käynnissä ja jatkui vilkkaana vielä havainnoinnin loppuessa. Yö oli melko lämmin, tyyni ja sumuinen. Vain muutama yksilö nähtiin sataman valoissa.

Porin rannikolla pyrstötiaisen syysvaellusten aikataulu on vakio vuodesta toiseen, vain yksilömäärät vaihtelevat. Ensimmäiset havaitaan syyskuun lopulla, huippuvaihe on lokakuun jälkupuoliskolla ja vaellus päättyy marraskuun puolivälissä. Pikkuparvia jää kiertelemään talveksi rannikolle. Kuolleisuuden katsotaan olevan vaelluksilla hyvin suuri, koska paluu keväällä merten takaa on harvinaista.

Syksyllä 1982 pyrstötiaisia havaittiin Satakunnassa hyvin vähän. Talvella lajia esiintyi jokseenkin normaalisti. Kuvatun havainnon lisäksi pyrstötiaisia havaittiin Satakunnan rannikolla keväällä 1983 huomattavasti normaalia enemmän.

Ovatko pyrstötiaisen vaellukset sittenkään sellaisia "kuolonvaelluksia" kuten uskotaan? Ehkä pyrstötiaiset palaavatkin keväällä parina huhtikuun lämpimänä yönä nopeasti rannikkoa pitkin. Tällöinhän rannikon lintuharrastajat ovat joko pöllöretkellä sisämaassa tai nukkumassa.

References

Eriksson, A. & Lilja, I. 1983: Toiminta Säpin lintuasemalla 1982. – Satakunnan Linnut 1983, 4:17–31.
v. Haartman, L., Hildén, O., Linkola, P., Suomalainen, P. & Tenovuo, R. 1963–72: Pohjolan linnut värikuvin. – Otava, Helsinki.
Hyytiä, K., Kellomäki, E. & Koistinen, J. (toim.) 1983: Suomen lintuatlas. – SLY:n Lintutieto Oy, Helsinki.
Lampolahti, J. & Virtanen, T. 1983: Katsaus syysmuuttoon 1982. – Satakunnan linnut 1983, 3:12–34.

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