Temporal trend for some mono-*ortho* and non-*ortho* CBs in Baltic Guillemot egg collected in 1969-1992.

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Introduction

Results from monitoring studies within the Swedish Environmental Monitoring Programme studying concentrations of various contaminants in Swedish matrices, including Baltic matrices, have shown a fairly consistent decreasing trend for various matrices regardless of sampling area and environment (1, 2, 3). The results are somewhat contradictory to predicted trends based on models for global transport of volatile and semi-volatile compounds (4, 5) but also to studies on air samples that clearly show the importance of temperature for the volatilisation of semi-volatile compounds in the environment (6, 7, 8). However, recent monitoring studies show stabilised PCB concentrations in herring from the western parts of the Baltic Proper during the last ten year period whereas there is a continuous decrease on the Swedish West Coast and in the Gulf of Bothnia (northern Baltic) (9). That study also showed a change in the congener composition indicating new emissions of PCB to of the Baltic Proper. In a study based on long term monitoring of Baltic herring, different temporal trends for specific CBs were indicated (10). The results could not be interpreted as the effect of global fractionation of PCB and the authors discussed the possibility of atmospheric degradation processes as explanatory factors. In the present study we investigate the temporal trends for some mono-*ortho* and non-*ortho* CBs in pooled samples of guillemot eggs collected at Stora Karlsö in the central part of the Baltic proper.

Material and Method

The eggs were collected annually in May at Stora Karlsö and each year's pool was comprised of aliquots from about ten eggs. The eggs used have earlier been used as a matrix for studies of temporal variation in concentrations of DDT, total PCB and other compounds (2, 11, 12). Samples were extracted, worked-up and analyzed for non-*ortho* and mono-*ortho* PCB using high resolution GC/MS (13). Log-linear regression analysis was applied for the studied period. The calculated annual change in concentrations (percent) has been calculated from the regression line for the investigated period. In order to study the relative change in concentrations of various congeners the annual ratio for the concentration of the single congener compared to the concentration of congener CB-169 was calculated. Congener CB-169 was regarded as fairly environmentally stable and a log linear regression analysis of the ratios has been applied for the study period as well.

Results and discussion

The results indicate a remarkable consistency in annual decrease regardless of congener (Table 1). The individual congeners studied decrease by 5.5-7.3 % annually and higher chlorinated congeners do not always decrease more slowly than lower chlorinated ones.

The Baltic is regarded as one of the most seriously PCB polluted marine environments in the world. Thus, there are reasons to regard the Baltic environment as a major PCB source if volatilisation is a major process for explaining the current environmental concentrations, since production and use of PCB has decreased. Use has obviously ceased since concentrations have decreased fairly rapidly.

Table 1. Annual change in concentrations as well as relative concentrations of total PCB and individual CB congeners in samples of guillemot eggs collected 1969-1992. For significance of the regression line: n.s.=not significant; p> 0.05; * p< 0.05; ** p < 0.01; *** p < 0.001.

Congener	**Concentration Annual change, %**	**Ratio CB/CB-169 Annual change, %**
CB-77 *3,4-3',4'*	-6.2***	-0.63 n.s.
CB-105 *2,3,4-3',4'*	-6.9***	-1.3**
CB-118 *2,4,5-3',4'*	-7.3***	-1.8***
CB-126 3,4,5-3',4'	-6.3***	-0.73*
CB-169 *3,4,5-3',4',5'*	-5.5***	-

Lower chlorinated compounds are normally considered less persistent with regard to calculated tropospheric lifetime due to reactions with OH-radicals (14) or enzymatic degradation processes (15). Lower chlorinated compounds are also generally more volatile than higher chlorinated ones (16).

According to calculated Henry's law constants (16), the tetra chloro CB, congener CB-77, is fairly volatile. However, this congener does not decrease significantly faster over time than the hexa chloro CB-169. If global fractionation processes are a major explanation for the changes over time, during a period of both uncontrolled use of PCB as well as improving environmental conditions in an area close to the source, CB-77 concentrations would be expected to decrease faster than CB-169. The present data for these congeners in guillemot eggs do not indicate that the less chlorinated CBs will more readily decrease over time than the more highly chlorinated CBs, whether the decrease is due to degradation or global fractionation. Interestingly another study on long term trend monitoring of Baltic herring revealed an obvious relationship between decreasing rate and increasing number of chlorine molecules in the congener (10).

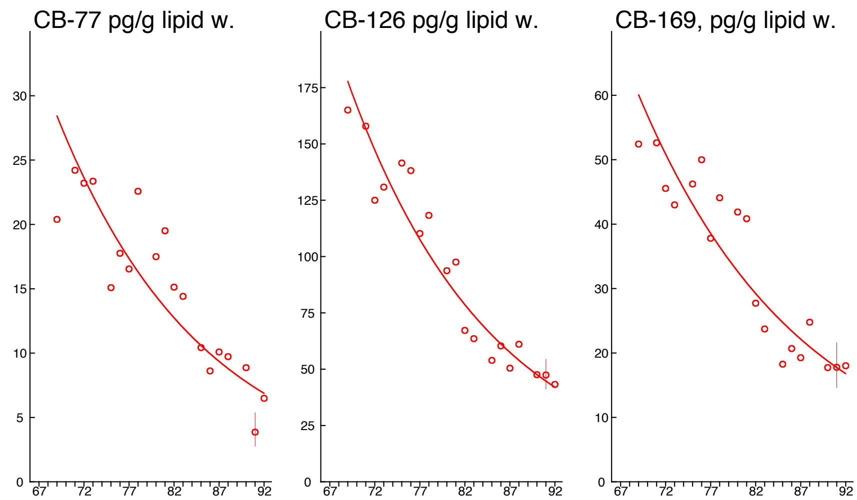

Figure 1. Concentrations of CBs -77, -126 and -169 showing the temporal trends for non-*ortho* CBs in lipids from guillemot egg (*Uria aalge*) collected at Stora Karlsö, the Baltic Proper.

The consistently high relative concentrations of the less persistent compounds over time in the present study could be a result of continuous environmental pollution in parallel with a continuous decrease in use and production. This implies that "new PCB" is polluting the Baltic and that international measures taken have not been efficient enough. However, considering the fairly constant congener composition over time the "new" PCB ought to have another congener composition than the former.

Another possibility is that the capability of guillemot to enzymatically metabolise certain CB congeners like CB-77 is induced by the pollutants. It has been shown experimentally that PCB-exposed mink have a lower retention of DDT compounds than less exposed mink (17). Similarly, Baltic adult grey seals with high concentrations of total PCB as well as DDT compounds did not biomagnify CB-118 and dioxins whereas young grey seals having much lower concentrations of total PCB and DDT compounds did (18, 19). Tentatively, a higher exposure from contaminants in the beginning of our study period could mean a higher induction of enzymes too, degrading certain CBs.
As has been pointed out earlier, a major problem when comparing relative concentrations of various congeners in environmental samples is the possibility of pattern changes due to continuous degradation processes in the environment such as atmospheric degradation by OH radicals and UV light (10). For example, congeners such as CB-118 can be the result of de-chlorination by UV light of CB-153. De-chlorination of CB-105 can give CB-77. Consequently, concentration changes can be a result of both environmental sinks and environmental transformation processes.

Although the material presented represents a unique set of comprehensive long term monitoring data we can not draw any firm conclusions. Thus, the presented results clearly show the difficulty of interpreting environmental processes from scattered data. In the literature, available data used for such interpretations are often far less comprehensive than in this study and the risk of drawing hasty and possibly incorrect conclusions is obvious.

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