PCB Congeners in Gannet (*Sula Bassana*) Eggs from the Scottish Coast: Temporal Trends (1977 - 1992) and Spatial Comparisons

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Introduction

This study explores total PCB and PCB congener trends in gannet eggs over a fifteen year period from 1977 to 1992. The eggs were sampled from Ailsa Craig, a colony situated in the northern part of the Irish Sea. In addition, the study compares congener data from eggs at Ailsa Craig with data from gannet eggs at four other UK. colonies.

The eggs used represent a historical series of matched matrices which Phillips (1) identifies as fundamental to understanding PCB behavior in the environment. The aims of the study are:

- to examine the temporal trends in total PCB and congener residue patterns over fifteen years
- to compare total PCB and congener residue patterns between different colonies
- to interpret the data in the light of other published work and using a knowledge of gannet ecology.

Materials and Methods

The eggs used in this study are from an archive of frozen eggs held by the Institute of Terrestrial Ecology. Some eggs used in this study have been used in previous studies to examine PCB time trends (2,3). However these studies reported PCB data as Aroclor equivalents, and the analysis took place over a long period. This study re-analyzed the eggs, using up to date GC-ECD methods with MSD confirmation.

The eggs used were collected shortly after laying. Approximately 10 eggs were sampled every two years between 1977 and 1992. They were held in archive at -30°C until being used for this study. They were analyzed using a method previously published (4) and data for congeners 52, 66, 101, 99, 119, 149, 118, 188, 153, 105, 138, 126, 187, 183, 128, 204, 180, 170, 201, 208 and 206 are reported. In addition five co-eluting pairs of congeners are reported: 61/74, 77/110, 82/151, 202/156 and 194/205. All of the data were subject to strict QA/QC criteria, and only passing data are reported.

Results

The study found a significant downward trend in the concentration of total PCB (reported as the sum of the congeners analyzed) in the eggs. The average total PCB in 1977 was 6.08 μg/g pa. falling to an average of 2.5 μg/g in 1992, a rate of decline of approximately 0.25 μg/g pa during this period.

For the individual PCB congeners, all congeners showed significant declines over the 15 year period. However the rates of decline for each congener differed, resulting in a congener pattern in 1992 that was significantly different from that in 1977. Principal components analysis was used to investigate the pattern differences with time, and this showed that an increase in the relative proportions of congeners 153, 183 and 280 was most strongly correlated with time.

The data from Ailsa Craig were compared to data found at four other colonies around the UK. This showed the PCB concentrations at colonies closer to populated areas were higher than those in remote areas, but that these differences were more pronounced in 1980 than they were in 1992. In addition, principal components analysis identified strong pattern differences between contaminated and remote colonies, with the patterns at the remote colony being characterized by a higher proportion of congeners 153 and 138.

Discussion

The rates of PCB decline found in this study are comparable to other trend studies published using gannet eggs and other sea bird eggs. The data suggest that concentrations of PCBs will continue to decline in UK. sea birds, although comparison with PCB data from terrestrial birds suggests that there is a different picture for land feeding birds (3).

The patterns of congeners found suggest it may be possible to characterize different bird populations from their pollutant loadings, but that with time and the absence of new PCB inputs, the patterns between colonies will tend to homogenize.

Gannet eggs were found to be a good indicator of regional (100 to 200 km) scale pollution because:

- eggs are a consistent media reflective of a constant population sector (breeding adult females)
- eggs have relatively consistent lipid content
- sea birds have higher PCB residue levels than terrestrial birds
- gannets live in discrete spatially defined colonies with little cross migration
- consistent long term sample sets are available
- gannet ecology is well documented
- gannets lay a single egg each year which limits variability due to clutch size
- median laying dates are similar from year to year, and
- gannets population are thriving, giving confidence that sampling programs are ecologically friendly.

The relationships between PCB congeners in the gannet eggs, and those found in other parts of the food web are explored in a related paper (5).

References

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