

SPATIAL AND TEMPORAL TRENDS IN PCDDs AND PCDFs IN EGGS OF HERRING GULLS (*Larus argentatus*) FROM THE GREAT LAKES, 1984-2003

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Introduction

Organisms at the top of aquatic food webs often reflect the maximum concentrations of available contaminants in the environment. On the Great Lakes, the Herring Gull (*Larus argentatus*) is one of the top aquatic predators and has been used as an indicator of environmental contaminant concentrations and their effects for more than 30 years.¹ The Herring Gull database is extensive with annual collections and analyses from the same 15 sites for over 75 compounds and congeners. Many of these data have been presented on a site or compound basis previously.^{2,3,4} The goal of this paper is to present a sampling of the available data on the temporal and spatial trends of PCDDs and PCDFs in Herring Gull eggs and to demonstrate the usefulness of the change-point regression method of analysis in assessing changes in temporal patterns within a time series.^{3,4,5}

Material and Methods

Herring Gull eggs were collected annually from up to 15 sites (Figure 1) from throughout the Great Lakes, 1974 to present. They were refrigerated for up to six weeks and then analyzed at the CWS National Wildlife Research Centre.^{3,6} Routine analyses were conducted for 18 PCDDs and 23 PCDFs from 1984 onwards. To assess which congeners had the greatest concentrations, means were calculated for the period 1998-2002 for each congener at each site. For spatial analysis, data were transformed using natural logarithm (ln) and ANOVA with the Student-Neuman-Keuls (SNK) test was used to assess differences in mean levels among colonies. Temporal trends were determined by change-point (piecewise) regression.^{3,4,5} The annual data for each compound were tested to identify the most statistically significant year to year change, i.e. the change point. Then the slopes of the regression lines, before and after a change-point were compared to each other to identify significant changes.

Results and Discussion

Among PCDDs, 2378 TCDD had the greatest concentration at 9 of 15 sites; OCDD was greatest at three sites; 12378 P5D was greatest at two sites and 123678 HxCDD was the greatest at one site. Among PCDFs, 23478 PCDF had the greatest concentration at all 15 sites. The concentration of the 2378 TCDF congener was low and ranged from 7.6 – 30.8% of the 23478 PCDF value.

Spatially, 2378 TCDD concentrations were greatest in gull eggs from Channel-Shelter Island (Lake Huron) (25.86 pg/g) and the four Lake Ontario and St. Lawrence River sites; they were least at Port Colborne (Lake Erie) (2.96 pg/g) and at two of the sites in the upper Lakes (Figure 2). 23478 PCDF values were also greatest at Channel-Shelter Island (12.95 pg/g) and least at Port Colborne (2.04 pg/g) (data not shown).

Temporal trend analysis showed that while TCDD had declined significantly at all 15 sites since 1984, the long term continuing trend was significant at only 67% of the sites (see sample location in Figure 3), i.e. concentrations had remained unchanged at 33% of the sites for several years. For 23478 PCDF, 12 of 15 sites showed a significant decline since 1984 but the long term continuing trend was significant at only 33% of the sites (see sample location in Figure 4).

Similar calculations and plots can be made for all compounds (and congeners) analyzed in the program. The Herring Gull Egg Monitoring program provides extremely useful data for tracking temporal and spatial patterns of contaminants in Great Lakes wildlife.

Acknowledgements

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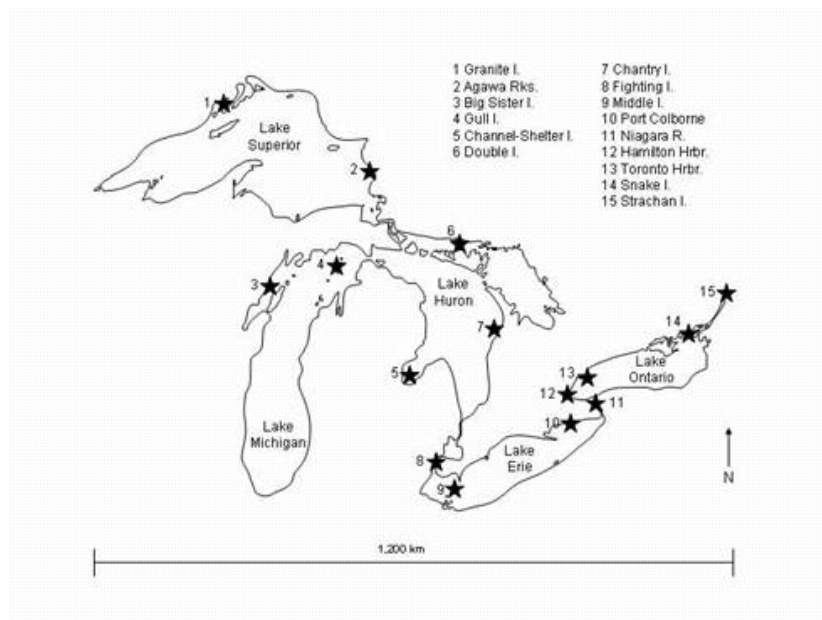


Figure 1. Map of the annual Herring Gull Monitor colonies.

EMV - Sources and Fate of POPs in the Great Lakes

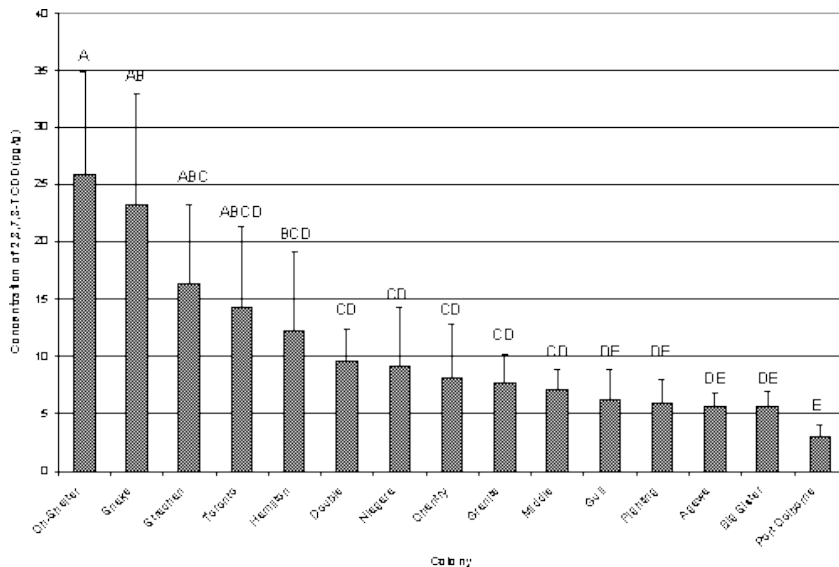


Figure 2. Spatial distribution of mean 2378-TCDD concentrations among 15 Herring Gull colonies, 1998-2002. Sites (histograms) which do not share a common letter are significantly different from one another.

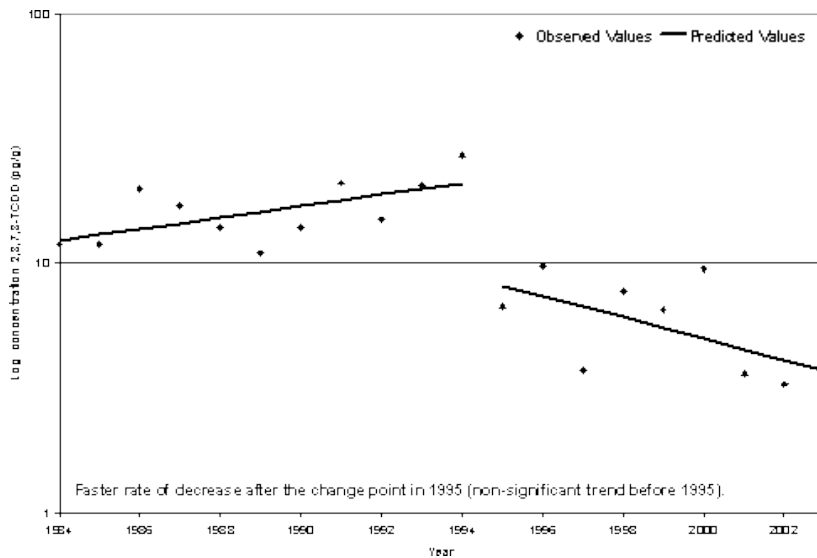


Figure 3. Temporal trend in concentration of 2378-TCDD in Herring Gull eggs from Gull Island, Lake Michigan, 1984-2003.

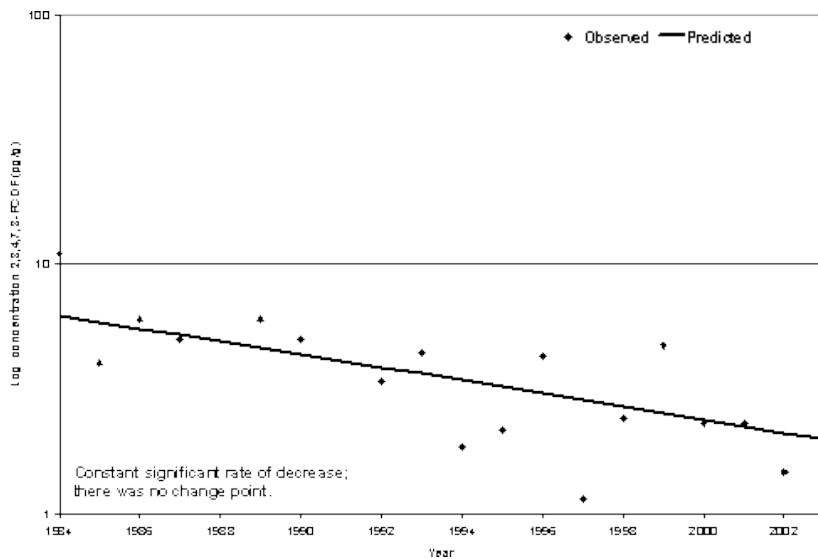


Figure 4. Temporal trend in concentration of 23478-PCDF in Herring Gull eggs from Toronto Harbour, Lake Ontario, 1984-2003.