

# Organohalogen contaminants in wildlife from the Yangtze River Delta

Development of methods and assessments of legacy and emerging persistent organic pollutants

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## Abstract

Rapid economic development has occurred during the past few decades in China with the Yangtze River Delta (YRD) area as one of the most progressive areas. The urbanization, industrialization, agricultural and aquaculture activities result in extensive production and application of chemicals. Organohalogen contaminants (OHCs) have been widely used as i.e. pesticides, flame retardants and plasticizers. They are persistent, bioaccumulative and pose a potential threat to ecosystem and human health. However, limited research has been conducted in the YRD with respect to chemicals environmental exposure.

The main objective of this thesis is to investigate the contamination level, distribution pattern and sources of OHCs in the YRD. Wildlife from different habitats are used to indicate the environmental pollution situation, and evaluate selected matrices for use in long term biomonitoring to determine the environmental stress the contamination may cause. In addition, a method is developed for dicofol analysis. Moreover, a specific effort is made to introduce statistic power analysis to assist in optimal sampling design.

The thesis results show extensive contamination of OHCs in wildlife in the YRD. The occurrences of high concentrations of chlorinated paraffins (CPs) are reported in wildlife, in particular in terrestrial species, (i.e. short-tailed mamushi snake and peregrine falcon). Impurities and byproducts of pentachlorophenol products, i.e. polychlorinated diphenyl ethers (PCDEs) and hydroxylated polychlorinated diphenyl ethers (OH-PCDEs) are identified and reported for the first time in eggs from black-crowned night heron and whiskered tern. High concentrations of octachlorodibenzo-*p*-dioxin (OCDD) are determined in these samples. The toxic equivalents (TEQs) of polychlorinated dibenzo-*p*-dioxin (PCDDs) and polychlorinated dibenzofurans (PCDFs) are at mean levels of 300 and 520 pg TEQ g<sup>-1</sup>lw (WHO2005 TEQ) in eggs from the two bird species, respectively. This is two orders of magnitude higher than European Union (EU) regulation limit in chicken eggs. Also, a novel pattern of polychlorinated biphenyls (PCBs) with octa- to decaCBs, contributing to as much as 20% of total PCBs therein, are reported in birds. The legacy POPs shows a common characteristic with relatively high level of organochlorine pesticides (i.e. DDT, hexachyclohexanes (HCHs) and Mirex), indicating historic applications. In contrast, rather low concentrations are shown of industrial chemicals such as PCBs and polybrominated diphenyl ethers (PBDEs).

A refined and improved analytical method is developed to separate dicofol from its major decomposition compound, 4,4'-dichlorobenzophenone. Hence dicofol is possible to assess as such. Statistic power analysis demonstrates that sampling of sedentary species should be consistently spread over a larger area to monitor temporal trends of contaminants in a robust manner.

The results presented in this thesis show high CPs and OCDD concentrations in wildlife. The levels and patterns of OHCs in YRD differ from other well studied areas of the world. This is likely due to the extensive production and use of chemicals in the YRD. The results strongly signal the need of research biomonitoring programs that meet the current situation of the YRD. Such programs will contribute to the management of chemicals and environment in YRD, with the potential to grow into the human health sector, and to expand to China as a whole.

**Keywords:** *Organochlorine pesticides, flame retardants, chlorinated paraffins, PCBs, PCDEs, PBDEs, PCDD/Fs, dicofol, environmental monitoring, bioindicator, shellfish, snail, bird eggs.*

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