ASSESSMENT OF PERSISTENT ORGANOHALOGENATED POLLUTANTS IN WHITE-TAILED SEA EAGLE FLEDGLINGS USING NON-DESTRUCTIVE BIOMONITORING STRATEGIES

Eulaers I[1], Hofman J[1], Covaci A[2], Halley DJ[3], Eens M[1] & Jaspers VLB[1]

[1] Ethology Research Group, Department of Biology, University of Antwerp, Universiteitsplein 1, B-2610 Wilrijk, Belgium; [2] Toxicological Centre, Department of Pharmaceutical Sciences, University of Antwerp, Universiteitsplein 1, B-2610 Wilrijk, Belgium; [3] Norwegian Institute for Nature Research (NINA), Unit for Terrestrial Ecology, Tungasletta 2, N-7485 Trondheim, Norway

Introduction

Predatory bird species have many characteristics that make them ideal biomonitor species and act as an early warning system, especially because of their apex position in the food chain[1]. As these species are endangered and/or protected, non-destructive sampling methods are required. Adult[2] and nestling feathers[3], but also blood[4] and preen oil[5,6], have already been evaluated as viable non-destructive biomonitors.

Here we report levels and patterns of contamination in blood, preen oil and feathers of white-tailed sea eagle (*Haliaeetus albicilla*) fledglings from Norway. Furthermore, we investigate the suitability of preen oil and feathers as non-destructive biomonitor matrices for assessing internal contamination with persistent organic pollutants (POPs). We emphasize the role of preen oil as possible external contamination source when using feathers as a monitoring matrix for POPs, as previously suggested by Jaspers et al.[7] and Dauwe et al.[8].

Materials and Methods

As part of a reintroduction program of white-tailed sea eagle (*Haliaeetus albicilla*; hereafter sea eagle) into Ireland, 20 juvenile sea eagles from Trøndelag (Norway) were captured. Juveniles were six to nine weeks old and almost ready to fledge the nest. Therefore we will refer to them as fledglings. While undergoing health checks in Norway, prior to transport to Ireland, the birds were sampled for body feathers, blood and preen oil. Blood was centrifuged and the resulting blood plasma was kept, together with the preen oil, at -20 °C until the day of analysis at the Toxicological Centre. Feathers were stored and shipped in envelopes.

Body feathers were pooled per individual, washed with distilled water, dried overnight and cut into ± 1 mm pieces. After sample preparation, between 220 and 700 mg of feathers were incubated overnight at 45 °C with HCl (4 M) and hexane/dichloromethane (4:1; v/v) and followed by liquid-liquid extraction. Further methodological details on feather analysis are reported by Dauwe et al.[8]. Preen oil analysis was executed following the protocol described by Dauwe et al.[9] and Voorspoels et al.[10]. Briefly, preen oil samples (< 76 mg) were weighed and mixed with anhydrous Na_2SO_4. Extraction was carried out for 2 h with 100 mL hexane/acetone (3:1, v/v) in an automated Soxhlet extractor in hot extraction mode. Lipid content was determined gravimetrically on an aliquot of the extract (dried for 1 h at 100 °C). The procedure for blood analysis is described by Covaci & Voorspoels[11]. Approximately 500 µL serum was mixed with 0.5 mL formic acid and 1 mL water and consequently vortexed for 20 min. The blood plasma was extracted using SPE cartridges (30 mg/ 1 mL; OASIS™ HLB). Extracts of feathers, blood plasma and preen oil were cleaned up on acidified silica columns.

All samples were analyzed for 36 PCB congeners (CB 18, 28, 31, 44, 47, 49, 52, 87, 95, 99, 101, 105, 110, 118, 128, 132, 138, 146, 149, 151, 153, 156, 170, 171, 172, 174, 177, 180, 183, 187, 194, 195, 199, 205, 206 and 209), eight PBDE congeners (BDE 28, 47, 49, 99, 100, 153, 154 and 183), dichlorodiphenyltrichloroethanes (*p,p'*-DDT and *o,p'*-DDT) and their metabolites (*p,p'*-DDE (hereafter DDE), *o,p'*-DDE, *p,p'*-DDD and *o,p'*-DDD), hexachlorobenzene (HCB), hexachlorocyclohexanes (HCHs; α-, β- and γ-HCH) and chlordanes (CHLs; *cis*-nonachlor (CN) *trans*-nonachlor (TN) and oxychlordane (OxC)). Detection and quantification of compounds were performed by gas chromatography-mass spectrometry (GC-MS)[8].

All statistical analyses were performed using R 2.11.0[12]. Samples with data below LOQ were assigned a value according to f x LOQ, where f is the proportion of samples ≥ LOQ. Compounds with $f < 0.50$ were not taken into account for statistical analysis. To meet the requirement of normality, all POP data were transformed according to $Y = \log_{10}(X + 1)$. The level of significance was set to $\alpha = 0.05$ and $0.05 < p < 0.10$ was considered a trend. Accumulation profiles for all three matrices were constructed. Only congeners present in all three matrices were statistically tested. Pearson correlations on transformed data were performed between measured