

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA16224

STSM title: European Raptor Biomonitoring Facility

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PURPOSE OF THE STSM:

The purpose of this STSM was the assessment of pan-European capacity for monitoring polychlorinated biphenyl (PCB) and dichlorodiphenyltrichloroethane (DDT) trends given earlier efforts from the scientific community. For this reason a large body of peer-reviewed publications on exposure to these contaminants in European raptors was compiled to perform the basis for a meta-analysis of pan-European spatial and temporal trends of PCBs and its congeners, as well as DDT and its metabolites (DDE and DDD). These compounds were chosen as they are legacy compounds that have demonstrated clear and major toxicity on raptors from different trophic levels.

This meta-analysis of pan-European spatiotemporal variation in PCB and DDT exposure will contribute to the identification of sentinel bird of prey species, their advantages and disadvantages, matrices, and habitats for the purpose of biomonitoring these toxic chemicals as well as provide a useful evaluation of the efficiency of national and European legislation of PCBs and DDTs. Such a major meta-analysis will show how the potential of studying raptors to identify pan-European spatiotemporal trends in exposure and effects of PCBs and DDTs and how regulatory actions can have an effect.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

Scientific and grey literature were searched for using Google Scholar, Web of Science and Scopus. Key words that were used are: DDT, dichlorodiphenyltrichloroethane, DDE, dichlorodiphenyldichloroethylene, PCB, polychlorinated biphenyls, common bird name (e.g. white-tailed eagle), scientific name (e.g. *Haliaeetus albicilla*). All reviewed literature was managed using the Mendeley reference management software.

The literature review is based on 12 diurnal and nocturnal raptor species, including white-tailed eagle (*Haliaeetus albicilla*), osprey (*Pandion haliaetus*), golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), common kestrel (*Falco tinnunculus*), common buzzard (*Buteo buteo*), goshawk (*Accipiter gentilis*), sparrowhawk (*Accipiter nisus*), long-eared owl (*Asio otus*), tawny owl (*Strix aluco*), barn owl (*Tyto alba*), and eurasian eagle-owl (*Bubo bubo*), as well as scavenging species, such as Egyptian vulture (*Neophron percnopterus*), cinereous vulture (*Aegypius monachus*), griffon vulture (*Gyps fulvus*) and bearded vulture (*Gypaetus barbatus*).

Two databases were created in Excel, one for PCBs and one for DDT and its metabolites. For the PCB database, 102 studies were reviewed, and for the DDT one 115 studies. Concentrations of PCBs, both individual congeners as their total sum, DDTs, including total sum, *p,p'*-DDT, *o,p'*-DDT, *p,p'*-DDE, *o,p'*-DDE, *p,p'*-DDD, *o,p'*-DDD were extracted, as well as any observation on potential toxic effects, dietary habits, matrix analysed, age class, sex, cause of death, and analytical method used.

For spatiotemporal descriptors, from each paper the year, country and region (if reported) of sampling was extracted to ultimately allow for a detailed spatiotemporal analysis of PCB and DDT trends. The spatial analysis will evaluate the geographical extend of DDT and PCB occurrence as well as source regions. Temporal trend analyses will show aim to show production trends and the influence of legislation. Both aspects of the spatiotemporal analysis are also focused on variations between commercial mixtures or parent compounds and congener composition or metabolites, respectively for PCBs and DDTs.

Harmonisation of reported results was a major undertaking, as the reported concentration units (now all harmonized to ng/g) and bases (now all available in lipid weight (lw) and wet weight (ww)) were reported with great inconsistency. Another harmonization issue encountered is the names of the DDT compounds analysed for, as well as the composition of the total sum of DDTs and PCBs. PCB concentration were reported as sum of PCB congeners of the reported congeners, as well as the internationally agreed upon 7 per convention of the World Health Organisation, as well as a custom sum including all congeners present in all literature. Finally, to allow for pan-European comparisons, all species were classified by guild, i.e. mammivorous (diurnal and nocturnal), piscivorous, avivorous and scavenging.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

During this STSM, 115 studies have been revised on 16 species, resulting for both compound classes in a databases including exposure and metadata as well as a literature database. The latter is realized in Mendeley format and includes a folder with full texts of the literature and any potential supplementary information. The former Excel database was divided into separate sheets for the studied 16 species. For each species, key information on author(s), species, country, region, sampling year(s), period 1 (sampling years classified by decades), period 2 (sampling years classified as pre-, during-, and post-use of the specific compound), effect (physiological effects), diet, number of samples, matrix (e.g. muscle), matrix type (e.g. breast muscle), being a time trend study, age class, sex, capital or income breeder, resident or migratory species, and analytical methods.

The reviewed literature concerning DDTs delivers a study period from 1962 to 2019. The most common compound reported is DDE. Only one study incorporated dicofol concentration because DDT is an intermediary in its production. The most common species studied are white-tailed eagle, peregrine falcon and sparrowhawk. Most of the data available are for northern and western European countries, of which Spain, Norway and Sweden constitute the top three. Chemical analyses were done on a wide variety of tissues and most often on eggs, liver and blood. Time trend studies were mostly done using white-tailed eagle and sparrowhawk, and where only performed using eggs, liver and blood. Clear data gaps exist for Southeast Europe and eurasian eagle owl, osprey and common kestrel.

The reviewed literature concerning PCBs delivers a study period from 1969 to 2019. The most often reported congeners are: 28, 52, 99, 101, 105, 118, 128, 138, 149, 153, 156, 170, 180, 187 and 194. The most common species studied are white-tailed eagle, sparrowhawk and common buzzard. Most of the data available are for northern and western European countries, of which Norway, Sweden and Spain constitute the top three. Chemical analyses were done on a wide variety of tissues and most often on eggs, liver and blood. Time trend studies were mostly done using white-tailed eagle, goshawk and sparrowhawk, and where only performed using eggs, liver and blood. Clear data gaps exist for Southeast Europe and scavenging species, eurasian eagle owl and osprey.

These first results will be analysed in-depth using statistical meta-analysis. These have, however, only recently started as the major part of the STSM's time had to be spend requesting old studies and grey literature, and harmonizing the reporting over more than 100 studies.

FUTURE COLLABORATIONS (if applicable)

This STSM will result in two review papers, respectively, on pan-European spatiotemporal trends of PCBs and DDTs, under supervision of Dr. Igor Eulaers. The continued work will be carried out in collaboration with key contributors from the ERBFacility network and will be funded with an Erasmus+ scholarship that was granted to the applicant.

Further collaborations are in progress as well, and in fact not only fill data gaps identified but also address COST Inclusiveness by assuring a collaboration between Croatian, German, Danish and Norwegian institutes. The foreseen collaborations include continuing toxicological analysis of raptors in Croatia as well as providing more long-term time trend studies.