

Feeling the heat: birds as bioindicators of flame retardant emissions from landfills

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Abstract - There is a vast reservoir of brominated flame retardants (BFRs) associated with waste electronics and soft furnishings that accumulate in UK landfills. Given concerns about the health impacts of such chemicals and their ability to bioaccumulate, this project will test the hypothesis that landfills represent an important source of BFRs to UK wildlife. This will be achieved by comparing concentrations of BFRs in gull eggs and tissues from landfill sites compared to both urban and rural locations. The project offers an exceptional opportunity for multidisciplinary research training that incorporates substantial components of both fieldwork and environmental analytical chemistry. We will work closely with Environment Canada to provide a secondment to Canada for the successful candidate to work collaboratively on the same taxon within a truly international context.

Project Description - In 2006, UNEP estimated the global production of electronic waste (e-waste) to total 20-50 million tonnes. Of that total, the EU-27 states generate 8.3-9.1 million tonnes per annum, a quantity estimated to be increasing by 3-5% year on year. Such e-waste is distinct both chemically and physically from other categories of municipal or industrial waste. While recycling e-waste is attractive because of its valuable base material and component content, it also contains high concentrations of environmental contaminants such as heavy metals and brominated flame retardants (BFRs). Manufacture of BFRs such as polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecanes (HBCDs) has been banned or restricted severely over the last decade owing to concerns about their adverse health impacts and propensity for bioaccumulation. Within the UK, the Waste Electronic and Electrical Equipment (WEEE) Regulations came into force in July 2007. These require collection of 65% of e-waste, and recovery of 85% of the collected material. This means that 35% of UK e-waste can still be disposed of untreated in landfill, augmenting the already substantial quantity of e-waste residing in UK landfills. Despite this mounting problem, only a few studies have demonstrated that BFRs like PBDEs leach to groundwater from landfilled e-waste, alongside evidence of elevated airborne concentrations of HBCDs in the vicinity of a UK e-waste treatment facility. Moreover, the impact of such emissions on concentrations in wildlife has yet to be evaluated. BFRs are also present at percent levels in soft furnishings (i.e. polyurethane foam and textiles), and building insulation foam. However, in contrast to e-waste, there is presently no legislation requiring special treatment of such materials during their disposal, and it is likely that most such items are landfilled in non-hazardous municipal and commercial waste facilities. The potential scale of this reservoir of BFRs is illustrated by a recent estimate that around 670,000 tonnes of furniture and 310,000 tonnes of textiles were disposed of by householders in the UK in 2011 alone.

The project will test the hypothesis that emissions from waste materials in landfill constitute an important source of BFRs to the environment and in particular to the terrestrial food chain. To do so, the project will measure concentrations of a range of both "legacy" (e.g. PBDEs) and "current use" BFRs in gull eggs and tissues sampled from: (a) landfill sites; (b) urban locations; and (c) rural sites. We hypothesise that concentrations in eggs and tissues of birds foraging at landfill sites will be significantly elevated compared to those that do not. We have selected gulls as our sentinel species because we already study gull species within the Centre for Ornithology in Biosciences. They are typically apex predators and omnivorous, thereby perhaps offering the best opportunities as consumers for biomagnification of these agents. Furthermore, our partners at Environment Canada have much experience of working with this taxon in their own similar PBDE studies in the Great Lakes basin; the research in Canada provides the opportunity to identify continental

differences in BFR exposure that may reflect such differences in BFR usage patterns between Europe and North America. The Persistent Organic Pollutants Research Group in GEES has substantial experience in the sophisticated analytical chemistry procedures required to monitor BFRs in the environment.

Figure: Foraging gulls at landfill – reproduced by permission of Ian Lewington



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