THE USE OF CONSERVATION DOG-HANDLER TEAMS TO COLLECT NONINVASIVE BIOLOGICAL SPECIMENS (FECAL MATTER) FOR ENVIRONMENTAL MONITORING: FLAME RETARDANT BURDENS IN MINK AND OTTER

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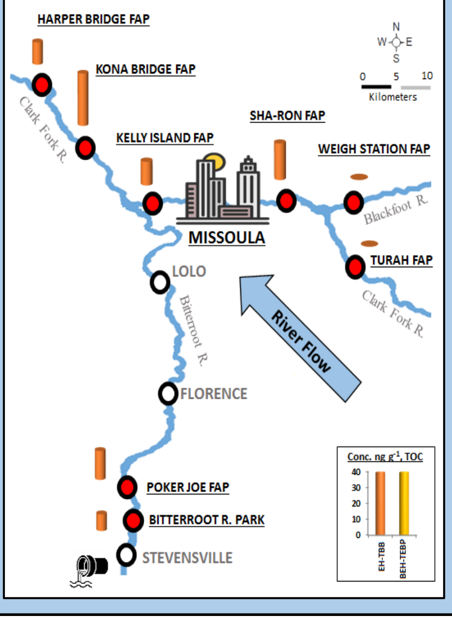
Abstract: Conservation dog-team located fecal matter from sentinel-species (mink (*Mustela vison*) and otter (*Lontra canadensis*)) at locations of the tri-river system of Missoula, Montana, USA (pop. 118,791). Sediments were also collected. Samples were analyzed for brominated flame retardants (BFRs): EH-TBB and BEH-TEBP, suspected endocrine disrupters. EH-TBB sediment detection rate 67%, conc. up to 58.0 ng g^{-1}, TOC. BEH-TEBP was not detected. Fecal samples contained both EH-TBB and BEH-TEBP, detection rates of 81% and 13% (conc. up to 1240 and 246 ng g^{-1}, l.w.), respectively. Fecal matter-derived body burden indicated that EH-TBB were at levels that ***may adversely affect healthy Mustelidae populations***. The ability to model organismal body burdens from fecal samples enhances the noninvasive value of this approach.

Introduction

The BFRs 2-ethylhexyl 2, 3, 4, 5-tetra-bromobenzoate (EH-TBB) and di (2-ethylhexyl)-2, 3, 4, 5-tetrabromophthalate (BEH-TEBP) have recently replaced polybrominated diphenyl ethers (PBDEs) from commerce due to human and environmental health concerns (U.S. EPA web-Link). However, these replacements have become environmentally disseminated and can disrupt reproductive and thyroid systems.[1] Fecal matter is a useful noninvasive/nondestructive media for evaluating contaminants in wildlife. Residues therein have been observed to track body burdens.[2] Working Dogs for Conservation (WD4C) trains rescued dogs to locate the feces of multiple species simultaneously, with a high degree of accuracy (WD4C web-Link). Their conservation dog-teams have proven to be very effective in helping researchers noninvasively collect fecal samples.[3] To better understand emerging anthropogenic threats and urban transfers to sentinel species, EH-TBB and BEH-TEBP exposure in free-ranging river otter and mink were investigated via habitat/sediment, fecal and body burden estimate analysis.

BFR analysis: Sediments and fecal matter were analyzed by UPLC APPI tandem MS (Analytical Method web-Link).

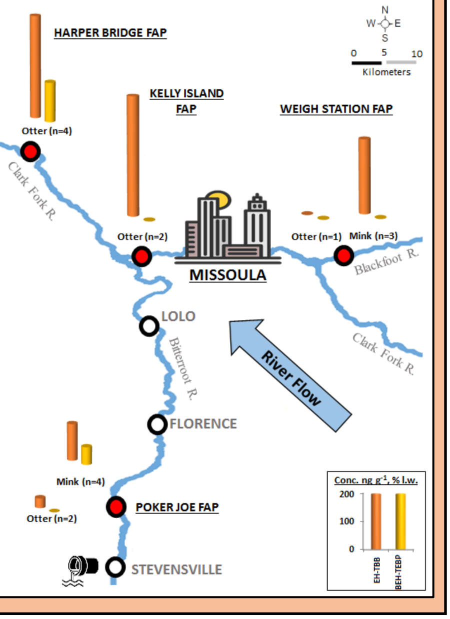


Sediments:

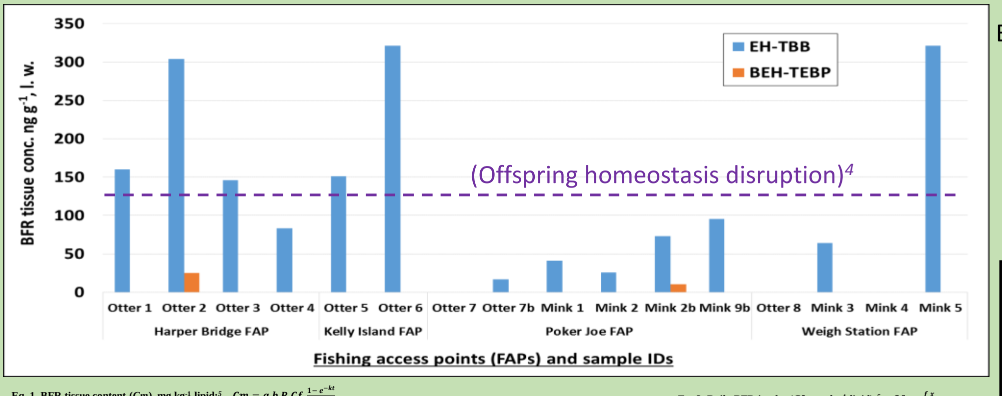
- 12 samples, 8 Fishing Access Points (FAPs)
- EH-TBB:
  - Urban influence (Missoula):
    - Conc. > Clark Fork R. (upper)
    - Not detected, Blackfoot R., Clark Fork R. (lower)
  - Wastewater influence:
    - Stevensville, low population density, pop. 1809
    - EH-TBB conc. Bitterroot R. < Clark Fork R.
- BEH-TEBP: Not detected

Fecal matter:

- 16 samples (otter 9, mink 7) from 4 of 8 FAPs
- EH-TBB detection rate exceeded BEH-TEBP
  - 81% vs. 13%, respectively
  - Urban influence (Missoula):
    - Conc. > Clark Fork R. (upper)
    - Blackfoot R. EH-TBB detected in mink (n=2)
      - However, non-detect Blackfoot R. sediments
  - Wastewater influence:
    - Stevensville, low population density, pop 1809
    - EH-TBB, BEH-TEBP conc. Bitterroot R. < Clark Fork R. (upper), Blackfoot R.



BFR tissue burden estimates derived from fecal matter (Cm)[4]:



Eq. 1, BFR tissue content (*Cm*), mg kg^{-1} lipid:[5] $Cm = a\, b\, R\, Cf\, \frac{1-e^{-kt}}{k}$

where: *Cm* - BFR tissue conc. (mg kg^{-1}, lipid)
a - % bioaccessibility efficiency [6]
b - conversion factor from fresh weight to lipid weight
R - g food per day per g body weight
Cf- daily BFR intake, Equation (2)
k - excretion constant
t - time over which BFRs are calculated (days) impact on reproduction

Eq. 2, Daily BFR intake (*Cf*), mg kg^{-1} lipid):[5] $Cf = \frac{f\,x}{E}$

where: *f* - amount (kg) of fat excreted per day
x - amount of BFR (mg kg^{-1} lipid) in fecal matter
E- % of BFR excreted [6]

Estimated adverse health effects:

- EH-TBB:
  - Exceeded in 38% sampled
    - 83% downstream of Missoula (Harper Bridge & Kelly Island FAP)
- BEH-TEBP, below adverse affects level

Conclusions: *(Additional info. & Contact web-Links)*

- EH-TBB & BEH-TEBP detected in Missoula's tri-rivers
  - Concentrations > downstream of Missoula
  - Urban population and wastewater influenced
- BEH-TEBP, ***only*** detected in fecal samples, not sediments
  - Fecal matter – a more inclusive matrix for environmental monitoring
- EH-TBB estimated tissue burdens may indicate adverse health affects within these Mustelidae populations.
- Noninvasive fecal collection facilitated by dog-handler teams and the ability to model organismal body burdens from fecal analysis are valuable, but underutilized, environmental monitoring tools.

References:

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