The accumulation of sedimentary PCBs in bullfrog (*Rana catesbeiana*) tadpoles from the Upper Hudson River

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Study Objectives

- Screening level survey of PCB contamination
- Preliminary measure for basing future investigations
Bullfrog Ecology

- Largest North American frog
- Native to Central and Eastern United States
- Highly aquatic
- Carnivorous
- Long lived (up to 10 yrs)
- Breed during late Spring in permanent water bodies
- Egg masses attached to submerged vegetation
Bullfrog Life Stages

Bullfrog Tadpoles

- Hatch out in Summer
- Over winter in sediments
- May reach lengths greater than 8 cm
- Primarily herbivorous – organic debris, algae, plant tissue, detritus
Study Sites
Sampling Synopsis

- Samples collected August-September 2003
- Sediment collected from 9 sites (2 reference)
- Composited sediment samples ($n = 9$)
- 155 tadpoles collected from 8 sites (6 study, 2 reference)
- Individuals were composited based on developmental stage (42 composited samples, $n = 1 - 12$)
- Tadpole gut coils were removed prior to analysis
Sampling
Total PCBs
Sediment [PCB]

The graph shows the PCB concentration (ppm) at various sites along the Hudson River. The sites are categorized into Hudson River Study Sites and Reference Sites. The concentration levels range from 0.01 to 100 ppm.

- **Hudson River Study Sites**: Site 7, Site 4, Site 3, Site 6, Site 5, Site 8
- **Reference Sites**: Site 1, Site 9

The sites are further divided into Upstream and Downstream sections. The bar heights indicate the PCB concentration levels at each site.
Tadpole [PCB]

PCB Concentration (ppm)

Reference Sites

Hudson River Study Sites

Upstream
Downstream
Sediment & Tadpoles

Sediment PCB Concentration (ppm)

Tadpole PCB Concentration (ppm)

\[ y = 0.07x + 503 \]

\[ R^2 = 0.89 \]
Tadpole Developmental Stage [PCB]

Hudson River Study Sites

PCB Concentration (ppm)

Reference Sites

PCB Concentration (ppm)
PCB Congeners

- 48 PCB congeners selected for quantification
- Selected congeners are found, historically, in PCB composition of various Hudson River physical and biological samples
- 12 ‘Dioxin-like’ PCB congeners included among the 48
# PCB Congeners

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PCB Congeners

Upper Study Sites

Lower Study Sites
Hudson River Study Site Sediment PCB Congener Composition

Upper Study Sites

- Fraction of Total
- Congeners: 8, 31/28, 47, 49, 52

Lower Study Sites

- Fraction of Total
- Congeners: 8, 31/28, 47, 49, 52
Hudson River Study Site
Tadpole PCB Congener Composition
Reference Site
Tadpole PCB
Congener Composition

Site 1

Site 9
Sediment vs Tadpole PCB Composition (One to One)
Tadpole : Sediment Ratios (TSRs)
Sediment Organic Carbon vs [PCB]

Tadpole Lipid Content vs [PCB]
Tadpole Sediment Ratios (TSRs)

Tadpole PCBs (normalized to total)

Sediment PCBs (normalized to total)
TSRs

Hudson River Study Sites

Site 1
Log Kow vs Log TSR

Hudson River Study Sites

Site 1
Study Site Log Kow vs Log TSR

- Di
- Tri
- Tetra
- Penta
- Hexa
- Hepta
- Octa
Conclusions

• Hudson River bullfrog tadpoles are contaminated with PCBs
• Tadpole PCB body burdens and congener distributions reflect sediment PCB loads and composition
• Sediment and tadpole PCB congener distributions varied little within and between study sites
• Reference site sediment and tadpole PCB congener composition differed markedly from study sites
• The majority of sediment PCB congeners are found in greater relative fractions in collocated tadpole tissues