USFWS Environmental Contaminant Investigations Related to Atlantic Salmon

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Tissue Residue Analyses

Fish accumulate contaminants through gill absorption and food

Documents exposure

Possible indicator of effects

Useful in directing future investigations or research

Useful in monitoring

Not useful for some contaminants (OPs, PAHs)
# USFWS Tissue Residue Investigations

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Species</th>
<th>Chemicals</th>
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</thead>
<tbody>
<tr>
<td>1997</td>
<td>Dennys River, East Machias River</td>
<td>Smallmouth bass (fillet &amp; offal)</td>
<td>PCB congeners, OCs, inorganics</td>
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<td></td>
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<td>Brook trout – Dead Stream (skin-on fillet)</td>
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<td></td>
<td>White sucker (wholebody)</td>
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<tr>
<td>2003</td>
<td>Dennys River</td>
<td>Smallmouth bass (fillet &amp; offal)</td>
<td>PCB congeners, inorganics</td>
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<td></td>
<td></td>
<td>White sucker (wholebody)</td>
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<tr>
<td>2003-2006</td>
<td>Seven DPS Rivers</td>
<td>White sucker (wholebody)</td>
<td>OCs, inorganics (also sex steroids, vitellogenin)</td>
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<tr>
<td>2004</td>
<td>Green Lake NFH</td>
<td>Atlantic salmon smolts – Penobscot (skin-on fillet)</td>
<td>PCDD/Fs, PCB congeners, OCs, Hg</td>
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<tr>
<td>2006</td>
<td>Cove Brook 2 Sheepscot Tribs (Finn, Weaver)</td>
<td>Brook trout (wholebody)</td>
<td>OCs, inorganics (also gill and liver EROD)</td>
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Total PCBs in Fish from Eight Rivers in the DPS and One National Fish Hatchery

- Dennys - 1997
- Dennys - 2003
- E Machias - 1997
- E Machias - 2006
- Pleasant - 2006
- Five DPS Rivers - 2003 to 2006
- Green Lake NFH - 2004
- Cove Brook - 2006
- Sheepscot Tribs - 2006

- BKT - Fillet
- BKT - Wholebody
- SmB - Fillet
- SmB - Wholebody
- W Sucker - Wholebody
- At Salmon smolt - Fillet

Nationwide Mean (BEST) - 0.084 ug/g
Salmonid residue effect threshold (RET) - 0.072 ug/g

(0.084 ug/g, Nationwide mean from Hinck et al. 2008)
(0.072 ug/g, Salmonid RET based on 3% lipid from Meador et al. 2002)
p,p'-DDE in Fish from Eight Rivers in the DPS and One National Fish Hatchery, ug/g wet weight

- Dennys - 1997
- DPS Rivers - 2003
- Green Lake NFH
- Cove Brook
- Finn Brook
- Weaver Brook

- SmB - Wholebody
- BKT - Wholebody
- W Sucker - Wholebody
- At Salmon smolt - Fillet

- Beckvar et al. 2005
- Hinck et al. 2008

- T-TEL (Tissue Threshold Effect Level) = 0.60 ug/g
- Nationwide Mean (BEST Program) = 0.045 ug/g

Graph showing p,p'-DDE levels in different fish samples from various rivers and hatcheries. The data points are below the t-TEL and nationwide mean values.
Organochlorine Compounds

White suckers and brook trout were below detection limits (< 0.002 ug/g, ww) for other organochlorine compounds

Chlordanes
Hexachlorocyclohexanes
Other DDT metabolites
Hexachlorobenzene
Endrin
Dieldrin
Mirex
Toxaphene (< 0.05 ug/g, ww)
Mercury in Fish from Eight Rivers in the DPS and One National Fish Hatchery, ug/g wet weight

- BKT - Fillet
- BKT - Wholebody
- SmB - Fillet
- SmB - Wholebody
- W Sucker - Wholebody
- At Salmon smolt - Fillet

Tissue threshold-effect level (t-TEL)
- Nationwide Mean (BEST Program)

(0.20 ug/g, t-TEL from Beckvar et al. 2005)
(0.13 ug/g, Nationwide mean from Hinck et al. 2008)
Other Inorganics

Arsenic, cadmium, chromium, copper, nickel, lead, selenium, and zinc levels (when detected) in wholebody white suckers from the DPS rivers were similar to median concentrations reported in national, regional, and Maine monitoring programs.
Wrap-up

Based on tissue residues analyses, eight rivers in the DPS were not grossly contaminated with OCs or most trace elements compared to national, regional, and state databases. Mercury remains a contaminant-of-concern in New England.

Sex steroid and vitellogenin investigation for white suckers was inconclusive. Few mature white suckers were collected. USGS/USFWS is conducting an endocrine disruption study with adult SmB from St. Croix (2008) and Penobscot (2009).

In the Region 5 National Fish Hatchery study, highest concentrations (Total PCB, TCDD-TEQ, Hg) found in 4-year, sea-run Merrimack River Atlantic salmon.

- Total PCBs 0.089 ug/g (BEST 0.084 ug/g / @ 5% lipid RET 0.120 ug/g)
- TCDD-TEQ 1.41 pg/g (BEST 1.50 pg/g)
- Hg 0.066 ug/g (BEST 0.13 ug/g / t-TEL 0.20 ug/g)

What are the contaminant levels of returning adults in Maine? Examine adult morts from traps? Examine eggs at hatchery during spawning?

Are juvenile salmon affected by low-level contaminant mixtures?
Annis M.L., D.M. Papoulias, J.E. Hinck and D.E. Tillitt. 2007. Histological staging and determination of the plasma 17 B-


