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Mercury in the Puget Sound food web: factors influencing body burdens in multiple species.

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Mercury in the Puget Sound food web: factors influencing body burdens in multiple species.

Laurie A. Niewolny, Sandra M. O’Neill, Stephen R. Quinnell, and James E. West
Total Mercury in Species Collected in Puget Sound

<table>
<thead>
<tr>
<th>Species</th>
<th>Total Hg in Muscle Tissue (ug/g wet weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coho (132)</td>
<td>0.0</td>
</tr>
<tr>
<td>Blackmouth (15)</td>
<td>0.3</td>
</tr>
<tr>
<td>Chinook (111)</td>
<td>0.6</td>
</tr>
<tr>
<td>Spot Prawn (49)</td>
<td>0.9</td>
</tr>
<tr>
<td>English Sole (528)</td>
<td>1.2</td>
</tr>
<tr>
<td>Dungeness Crab (82)</td>
<td></td>
</tr>
<tr>
<td>Pacific Cod (29)</td>
<td></td>
</tr>
<tr>
<td>Lingcod (2)</td>
<td></td>
</tr>
<tr>
<td>Staghorn Sculpin (12)</td>
<td></td>
</tr>
<tr>
<td>Copper Rockfish (36)</td>
<td></td>
</tr>
<tr>
<td>Quillback Rockfish (229)</td>
<td></td>
</tr>
<tr>
<td>Brown Rockfish (12)</td>
<td></td>
</tr>
<tr>
<td>Yelloweye Rockfish (2)</td>
<td></td>
</tr>
<tr>
<td>Sixgill Shark (20)</td>
<td></td>
</tr>
</tbody>
</table>
Contaminant tissue data is a snapshot of an individual animal taken at a specific moment in its life.

1. proximity to the contaminant
2. age
3. trophic level
4. movement patterns
5. life stage
6. lipid content of tissue
7. gender
Contaminant tissue data is a snapshot of an individual animal taken at a specific moment in its life.

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2. age
3. trophic level
4. movement patterns
5. life stage
6. lipid content of tissue
7. gender
### Mercury and the Puget Sound

<table>
<thead>
<tr>
<th>Source</th>
<th>Percent of Total Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermostat Disposal</td>
<td>0.13² [0.11 - 0.16]</td>
</tr>
<tr>
<td>Fluorescent Lamp Disposal</td>
<td>0.1</td>
</tr>
<tr>
<td>Air Emissions from Ind/Com/Instit. Sources</td>
<td>0.05² [0.02 - 0.07]</td>
</tr>
<tr>
<td>Crematoria Emissions</td>
<td>0.04</td>
</tr>
<tr>
<td>Cement Plants</td>
<td>0.04² [0.02 - 0.06]</td>
</tr>
<tr>
<td>Auto Convenience Switch Disposal</td>
<td>0.03</td>
</tr>
<tr>
<td>Petroleum Refineries</td>
<td>0.033</td>
</tr>
<tr>
<td>Dental Amalgam Excretion and Disposal</td>
<td>0.03</td>
</tr>
<tr>
<td>Button Cell Batteries</td>
<td>0.02</td>
</tr>
<tr>
<td>Steel Mills</td>
<td>0.016</td>
</tr>
<tr>
<td>Residual Oil Combustion</td>
<td>0.01</td>
</tr>
<tr>
<td>Residential Fuel Use, except Wood</td>
<td>0.007</td>
</tr>
<tr>
<td>Pulp and Paper Mills</td>
<td>0.006</td>
</tr>
<tr>
<td>Thermometers (Household)</td>
<td>0.005</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>0.002</td>
</tr>
<tr>
<td>Other Industrial and Military Facilities</td>
<td>0.001</td>
</tr>
<tr>
<td>Gasoline and Diesel Combustion</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

**Total:** 0.54 t/yr

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WEELLLL, I AM THE TUNA!!!

AND YOU KNOW I'M DOLPHIN-FREE!!

BUT B-B-BABY I'M LOADED...

WITH METHYL-MERCURY!!

HEAVY METAL IN THE MARINE ENVIRONMENT

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http://strangematter.sci.waikato.ac.nz/
Methylmercury vs. Total Mercury
Ten Puget Sound Fish and Macroinvertebrates

Log$_{10}$ TotalHg in Muscle (ug/g wet weight)

Log$_{10}$ MethylHg in Muscle (ug/g wet weight)

Blackmouth
Chinook
Coho
Dungeness Crab
English Sole
Lingcod
Quillback Rockfish
Sixgill Shark
Spot Prawn
Staghorn Sculpin

$1:1$

$r^2 = 0.92$
age
trophic level
proximity to the contaminant
movement patterns

Elliott Bay
Total Mercury in Muscle
Elliot Bay Species

Age in Years

Total Hg in Muscle (ug/g wet weight)

$r^2 = 0.86$

Dungeness Crab
English Sole
Lingcod
Mussel (*Mytilus trossulus*)
Quillback Rockfish
Spot Prawn
Total Mercury in Muscle - Quillback Rockfish and English Sole from Elliott Bay

Quillback Rockfish
\[ r^2 = 0.83 \]

English Sole
\[ r^2 = 0.35 \]
Trophic Level Comparison
Five Species from Elliott Bay

- lingcod
- rockfish
- English sole
- Dungeness crab
- spot prawn

Trophic level:
- C\(^{13}\) (ppt)
- N\(^{15}\) (ppt)

Trophic levels:
- Estuarine
- Oceanic
- Secondary consumers
- Tertiary consumers
Rockfish sampling locations:
Total Mercury in Muscle - Puget Sound Demersal Rockfish

Age in Years

0 10 20 30 40 50 60

Total Hg in Muscle (ug/g wet weight)

0.0 0.2 0.4 0.6 0.8 1.0 1.2

$r^2=0.82$

Urban
Total Mercury in Muscle - Puget Sound Demersal Rockfish

Age in Years

0 10 20 30 40 50 60

Total Hg in Muscle (ug/g wet weight)

0.0
0.2
0.4
0.6
0.8
1.0
1.2

Non-Urban

Urban

r^2=0.82

r^2=0.80
Sediment and Age Effects on Mercury in English Sole Across Puget Sound

$r^2 = 0.62$

sediment Hg only accounts for 2% of variation
Conclusions:

- Total mercury can be used to predict methylmercury in muscle
- **Age** is a major factor in the accumulation of mercury
- **Trophic level** and **movement patterns** affect the uptake of mercury between species
- Puget Sound rockfish indicate two different trends relative to the **proximity to the contaminant**.
Puget Sound Ecosystem Monitoring Program
Toxics in Biota Team

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