Longitudinal Indicators of Policy Impact: PCB Ban

Mary A. Fox, PhD, MPH
Johns Hopkins University
Bloomberg School of Public Health
Overall Project Objectives and Approach

• Objectives
  – To develop and present state level environmental health outcome indicators that measure changes over time; and
  – To apply environmental health outcome indicators to evaluate the impact of environmental policies on population exposures and health risks.

• Approach: Application of risk assessment
Current context – NJ Advisories

http://www.state.nj.us/dep/dsr/fishadvisories/fish-i-fish.htm
Policy change: PCB Ban and Phase-out

http://www.epa.gov/history/topics/pcbs/01.html
PESTICIDES FOUND IN SALT-WATER FISH

• New York Times February 27, 1983
• THE state's Department of Environmental Protection has determined that the same edible salt-water fish found to have potentially harmful levels of polychlorinated biphenyls also contain pesticides that could be dangerous to human health.
PCB Data Sources

- NJ fish tissue monitoring reports
  - Belton and Lockwood 1982 (shown at left)
  - Hauge et al. 1993 Results from New Jersey’s Toxics in Biota Monitoring Program
  - Horwitz et al. 2008 Routine monitoring of toxics in New Jersey fish
Summary of PCB Sampling Results, Bass in New Jersey waters, ug/g wet weight

<table>
<thead>
<tr>
<th>Analyte / Time Period / Number of Samples / Species</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arochlor 1254 / 1975-1980 / 54 / Striped Bass</td>
<td>1.58</td>
<td>0.12, 31.4</td>
</tr>
<tr>
<td>Total PCB / 1988-1989 / 55 / Striped Bass</td>
<td>1.24</td>
<td>0.48, 3.33</td>
</tr>
<tr>
<td>Total PCB / 2006 / 5 / Hybrid Striper</td>
<td>0.14</td>
<td>0.08, 0.27</td>
</tr>
</tbody>
</table>

Photo source: http://srac.msstate.edu/bass.htm
Risk Assessment Approach

• Look at child and adult exposure to PCB through consumption of fish
  – Consumption on per capita basis and consumer-only
• Standard procedures to estimate average daily dose
• Characterize risk for non-cancer health effect
  – Hazard Quotient = Estimated dose / RfD
Risk Assessment Inputs

• Consumption and body weight data from EPA Exposure Factors Handbook (2009)

• Bioavailability of PCBs: Xing et al (2008) found 3% was accessible from fish

• Dose = Concentration*Intake*Bioavailability / Body Weight

Xing et al. 2008. Environmental Pollution 156:1218-1226
## Indicator of Policy Impact: HQ

<table>
<thead>
<tr>
<th>Population</th>
<th>Arochlor 1254 Striped Bass, 1975-1980 Median (Min, Max)</th>
<th>Ban/Phase out</th>
<th>Total PCB Striped Bass, 1988-1989 Median (Min, Max)</th>
<th>Total PCB Hybrid Striper, 2006 Median (Min, Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adult Per Capita</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Tendency</td>
<td>1.4 (0.2, 4.4)</td>
<td></td>
<td>0.2 (0.1, 0.5)</td>
<td>0.02 (0.01, 0.04)</td>
</tr>
<tr>
<td>High (95th%ile)</td>
<td>9.1 (0.1, 29)</td>
<td></td>
<td>1.5 (0.5, 3.1)</td>
<td>0.1 (0.07, 0.2)</td>
</tr>
<tr>
<td><strong>Child Per Capita</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Tendency</td>
<td>1.7 (0.2, 5.5)</td>
<td></td>
<td>0.3 (0.1, 0.6)</td>
<td>0.03 (0.01, 0.5)</td>
</tr>
<tr>
<td>High (95th%ile)</td>
<td>10 (0.1, 31)</td>
<td></td>
<td>1.6 (0.5, 3.2)</td>
<td>0.2 (0.08, 0.3)</td>
</tr>
<tr>
<td><strong>Child Consumer Only</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Tendency</td>
<td>32 (0.4, 101)</td>
<td></td>
<td>5.2 (1.6, 11)</td>
<td>0.5 (0.3, 0.9)</td>
</tr>
<tr>
<td>High (95th%ile)</td>
<td>102 (1.4, 325)</td>
<td></td>
<td>17 (5, 34)</td>
<td>1.6 (0.8, 2.8)</td>
</tr>
</tbody>
</table>
Findings (1)

• Median PCB concentrations declined by an order of magnitude from late ’70s to 2006
• Max PCB concentrations declined by two orders of magnitude from late ’70s to 2006
• Child exposure scenarios yielded highest exposures and risks
Findings (2)

• Pre-ban all adult and child scenarios had HQ>1 at the median

• Early post ban/phase out
  – HQ>1 for adult and child percapita consumption at 95th%ile
  – HQ>1 for the child consumer (at median and above)

• Recent sampling (2006)
  – Only child consumer at 95th%ile has HQ>1
Indicator Conclusions

• This approach illustrates the success of the ban over the long term
• Documents the continuing need for exposure reduction policies for potentially vulnerable populations
EPHI for Policy Evaluation

• Valuable tool
• Can do a lot with a little (could do more with more?)
  – Data planning
    • Maintain monitoring programs
    • Other kinds of data (biomonitoring, health outcome surveillance?)
  – Methods that make clear link to policy
Thank you!