

PCBs in Fish and Invertebrate Tissues in Lower Duwamish Waterway

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Introduction

- a comparison of total PCB analyzed as the sum of Aroclors versus the sum of the PCB congeners in benthic invertebrate, clam, fish and crab tissues
- analyses conducted for LDW Risk Assessments and Remedial Investigation

Objectives

- The two methods for analyzing PCBs: Aroclors and congeners
 - PCB congeners provides the most accurate analysis of the total PCBs; however, the analytical costs are much higher compared to Aroclors
 - Aroclors is based on representation of the mixture of PCB congeners in the sample as Aroclors; for various reasons (e.g., weathered samples, preferential uptake) this method can produce over or underestimation of the total PCBs
 - Aroclors analyses are cost-effective and have been the dominant method for many years

Objectives (cont)

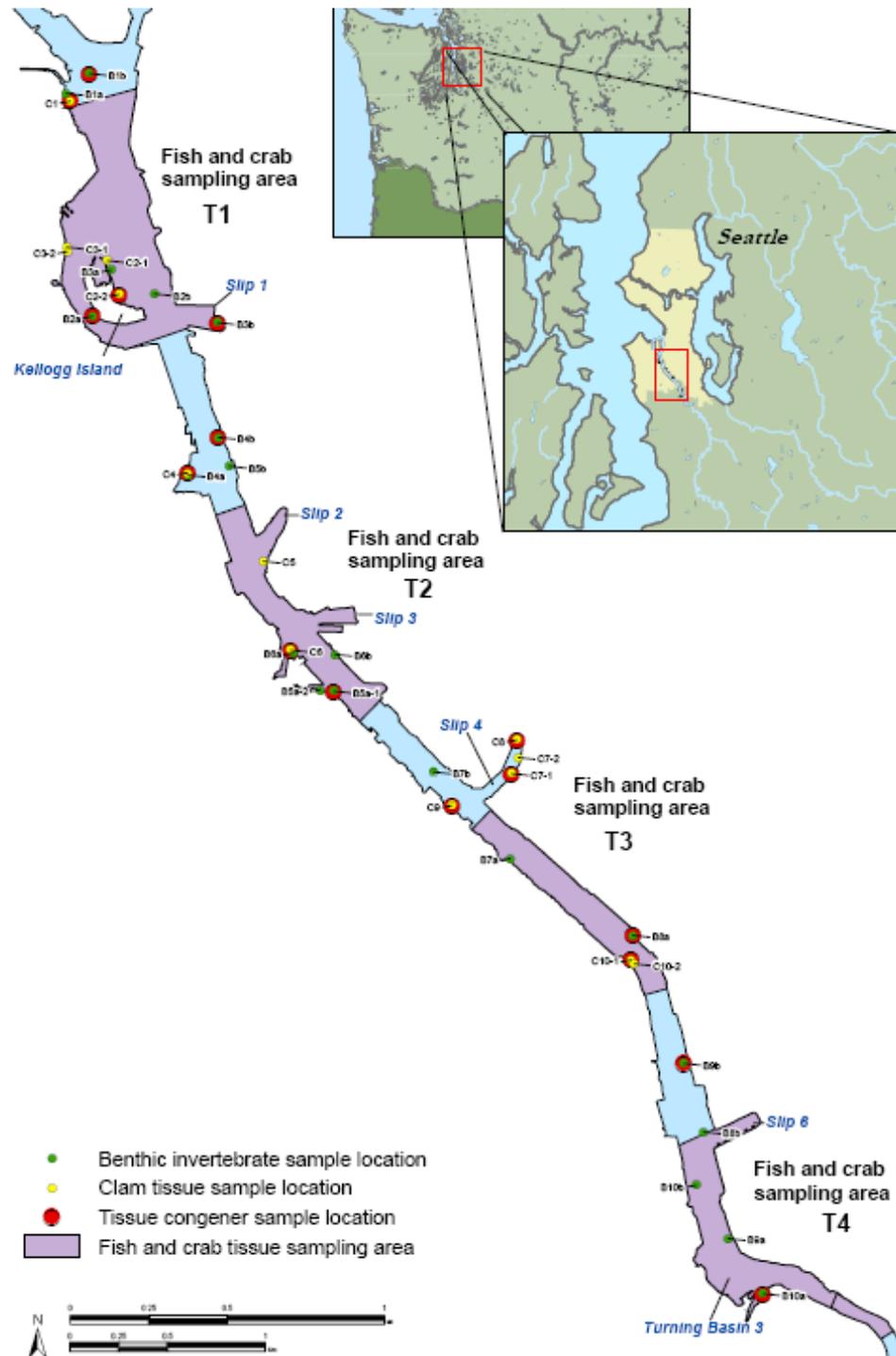
- PCB congeners were analyzed for two reasons:
 - to determine if total PCBs based on Aroclors sums can be used as a cost-effective measure of total PCBs. Additionally, historical data are aroclor-based.
 - To calculate risks from dioxin-like PCB congeners

Methods

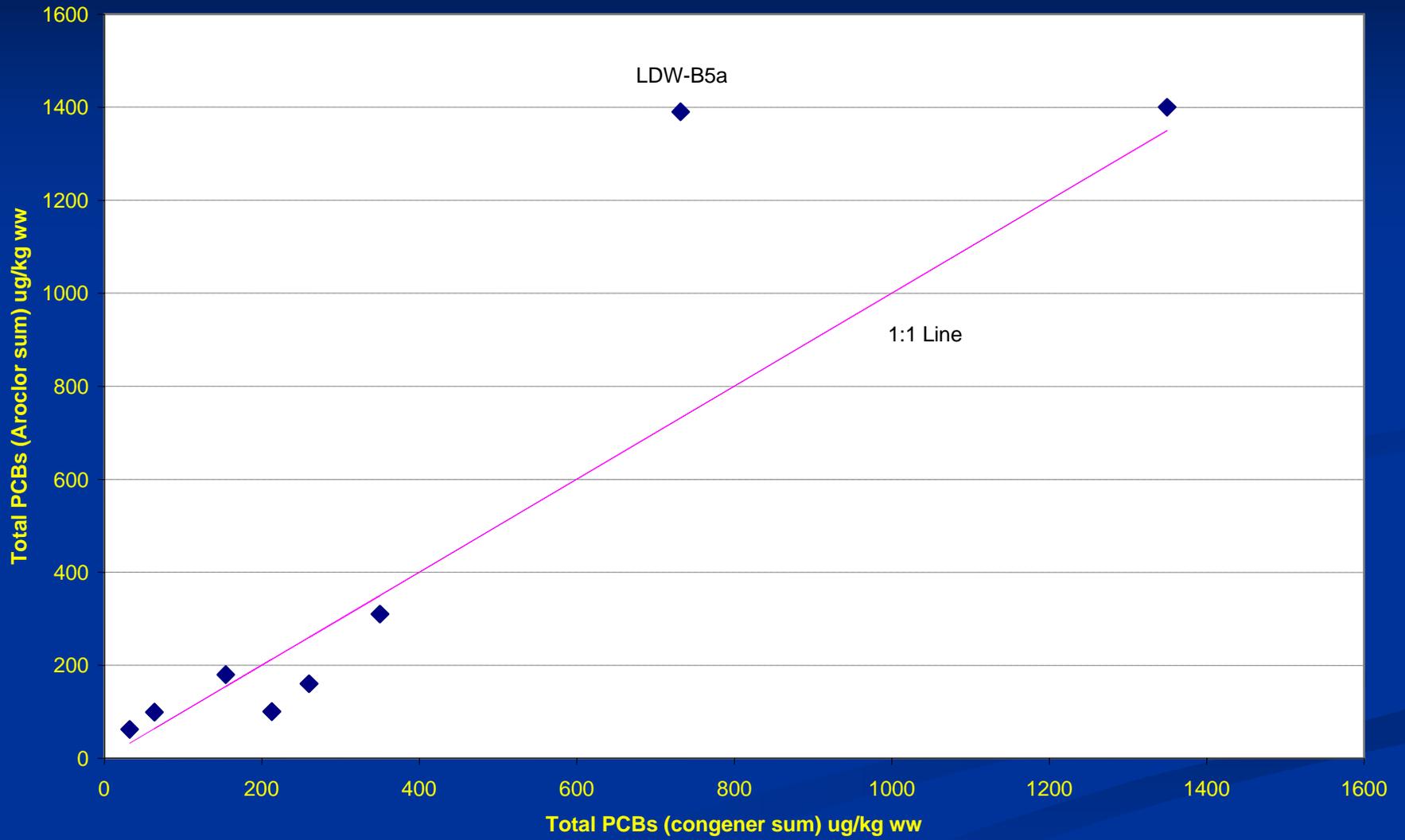
- Aroclor analysis conducted on:
 - 20 benthic invertebrate samples
 - 14 composite clam samples
 - 26 Dungeness and slender crab composite samples (edible meat and hepatopancreas)
 - 69 fish composite samples (English sole, shiner surfperch, Pacific staghorn sculpin)

Methods (cont)

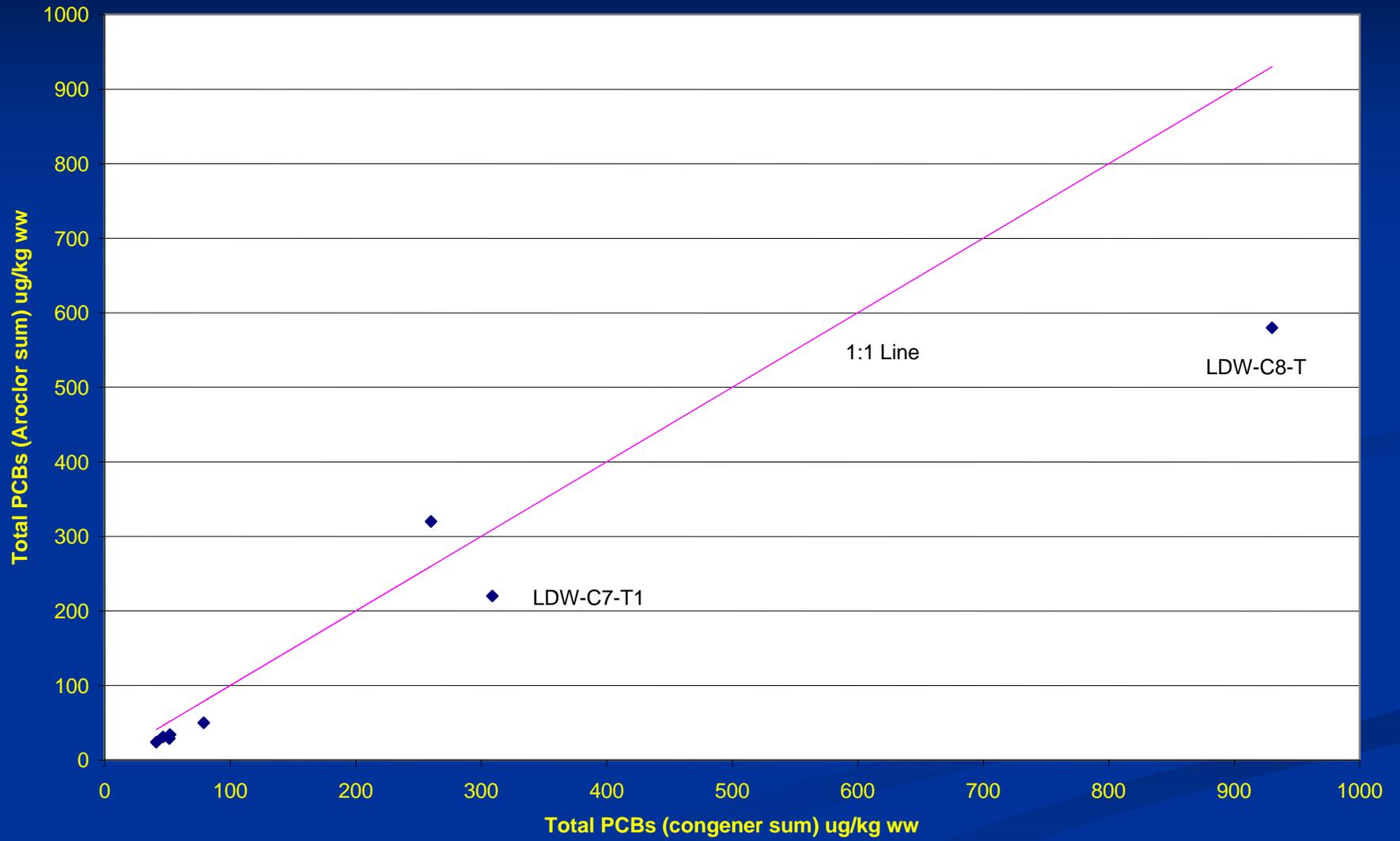
- One-third of each tissue type for a total of 51 samples was selected for congener analysis (all 209) based on:
 - the concentration range of total PCBs (Aroclor sum)
 - spatial distribution of samples collected
 - consideration of the aroclor pattern identified



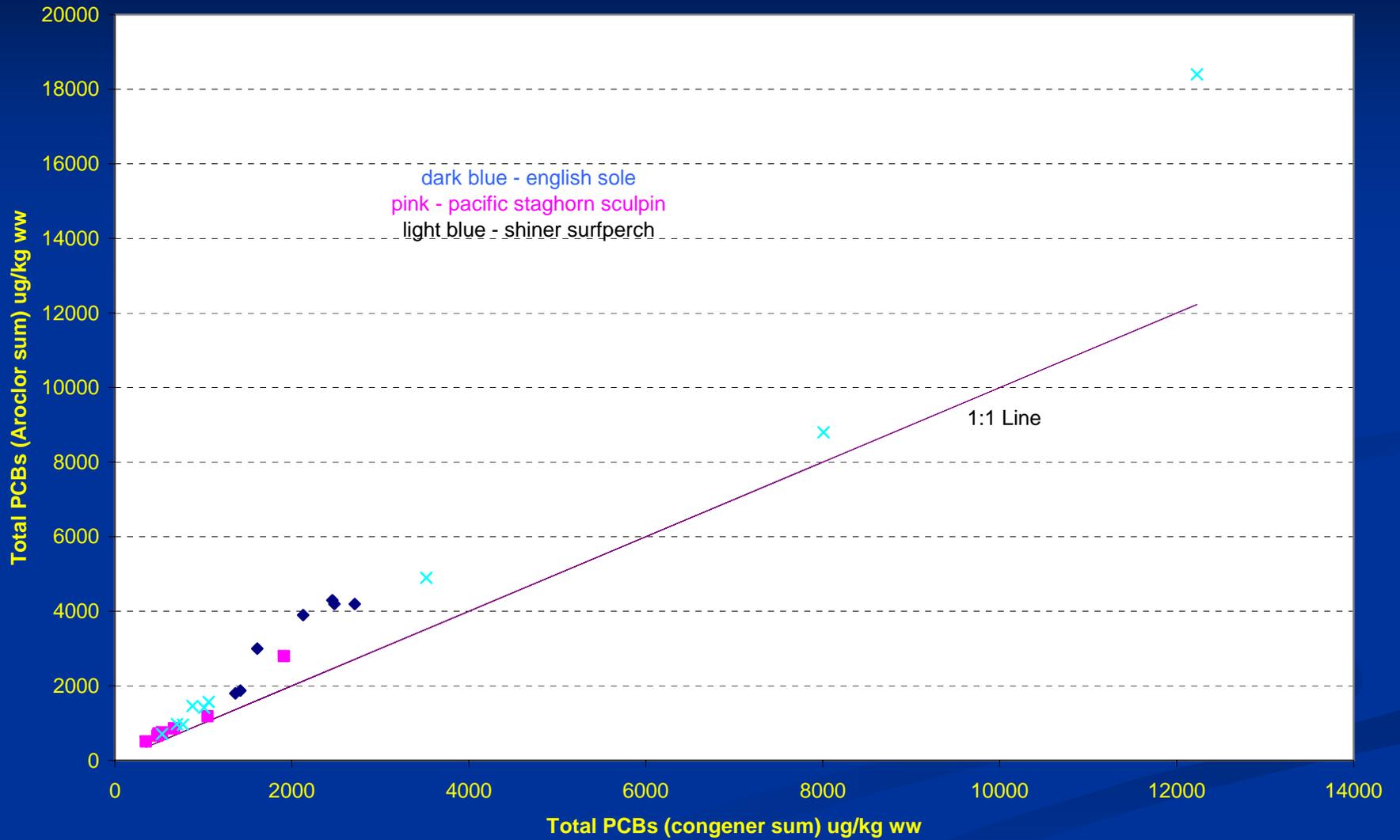
PCB Congener total vs Aroclor total for benthic invertebrate tissue



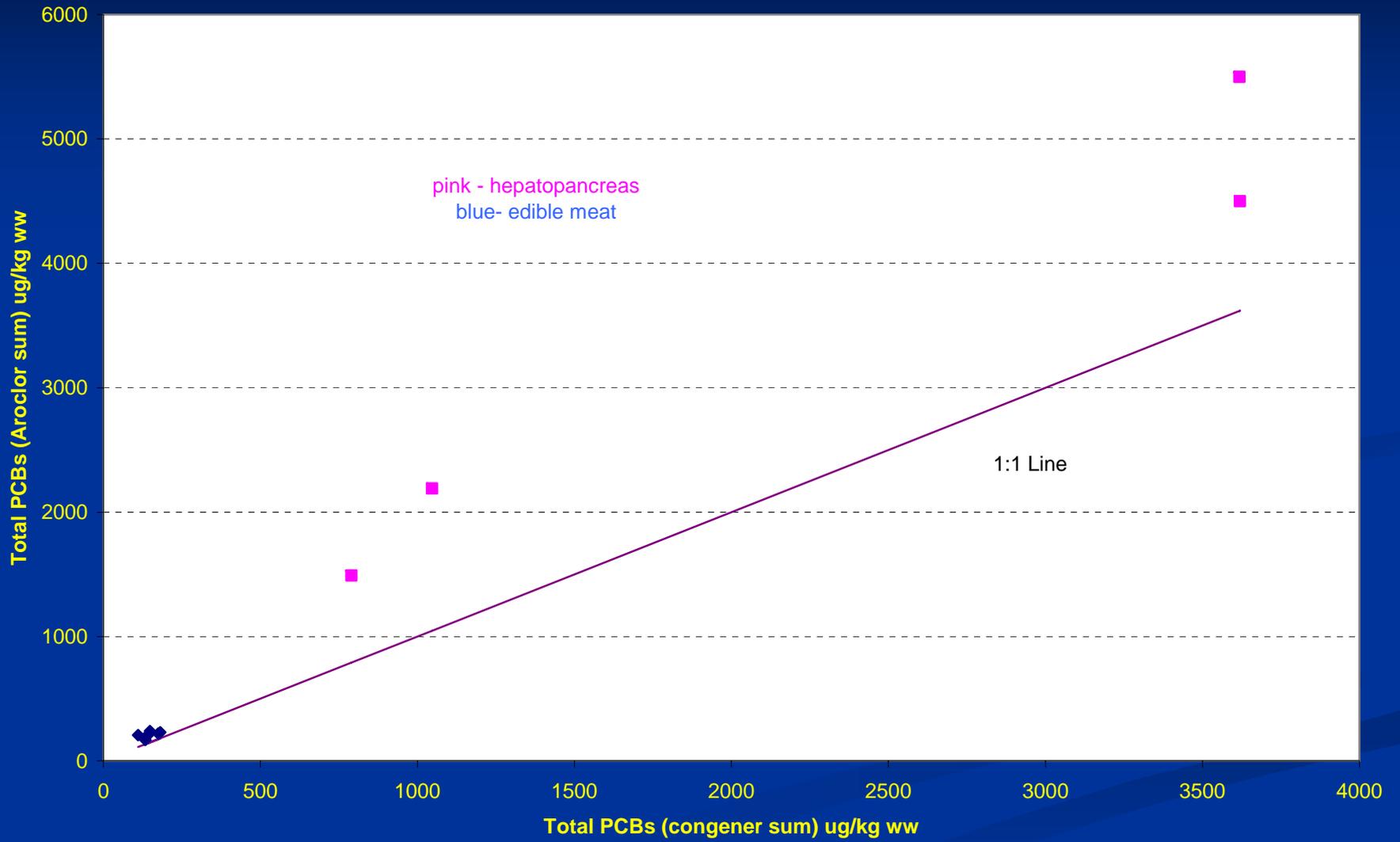
PCB Congener total vs Aroclor total for clam tissue



PCB Congener Total vs. Aroclor Total for Whole-body fish



PCB Congener Total vs. Aroclor Total for Crab tissue



Results - method comparison

- Ratios greater than one indicate that the Aroclor sum overestimated the congener sum and ratios less than one indicate that the Aroclor sum underestimated the congener sum. The clam tissue samples are the only samples for which the mean ratio is less than one.

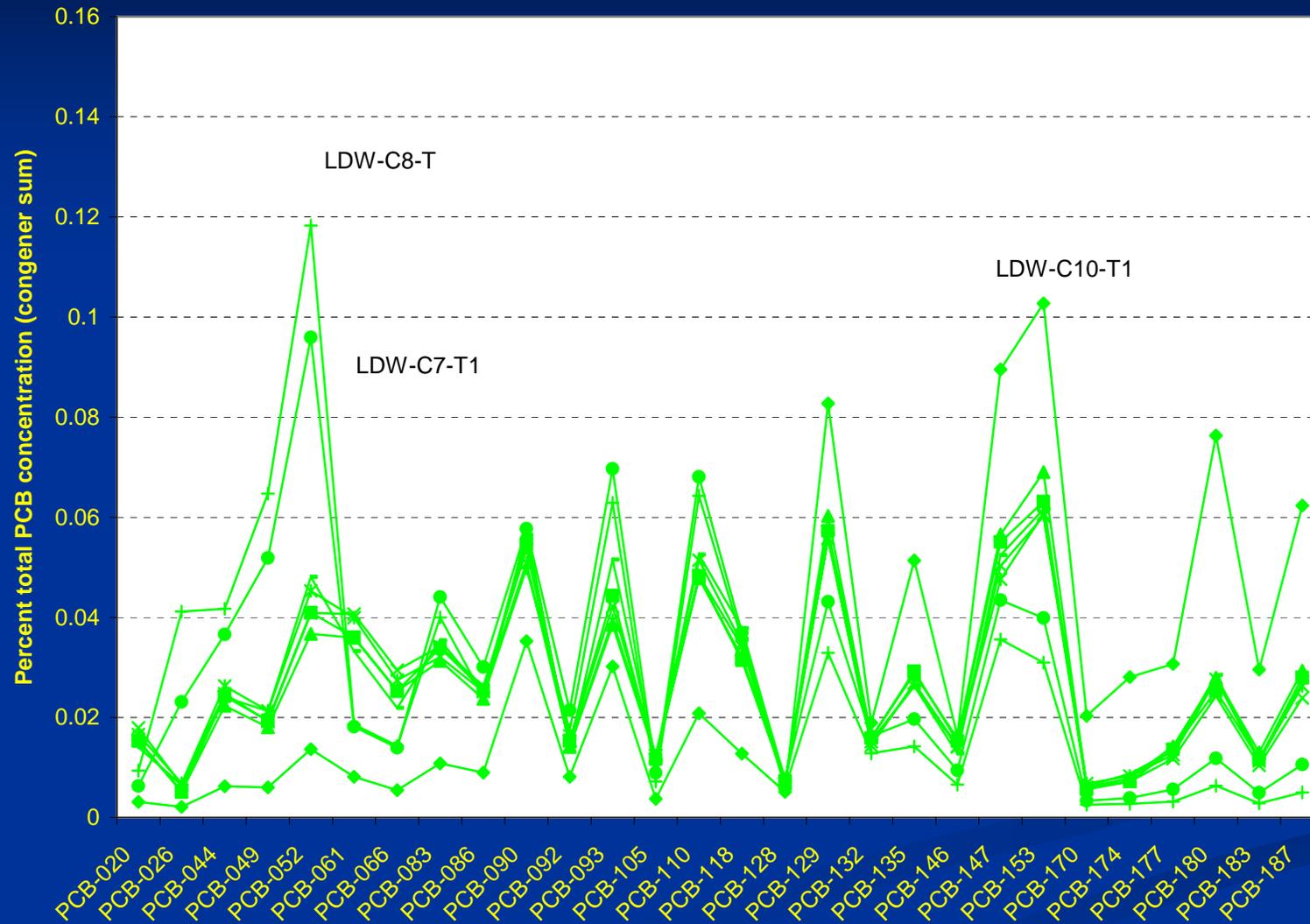
Mean ratio of Aroclor sum to congener sum

Sample	Mean Ratio of Aroclor sum to congener sum
Benthic Invertebrate tissue	1.19 ± 0.55
Clam tissue	0.71 ± 0.22
English sole	1.62 ± 0.23
Pacific Staghorn sculpin	1.37 ± 0.12
Shiner surfperch	1.39 ± 0.16
Crab –edible meat	1.45 ± 0.23
Crab - hepatopancreas	1.69 ± 0.38

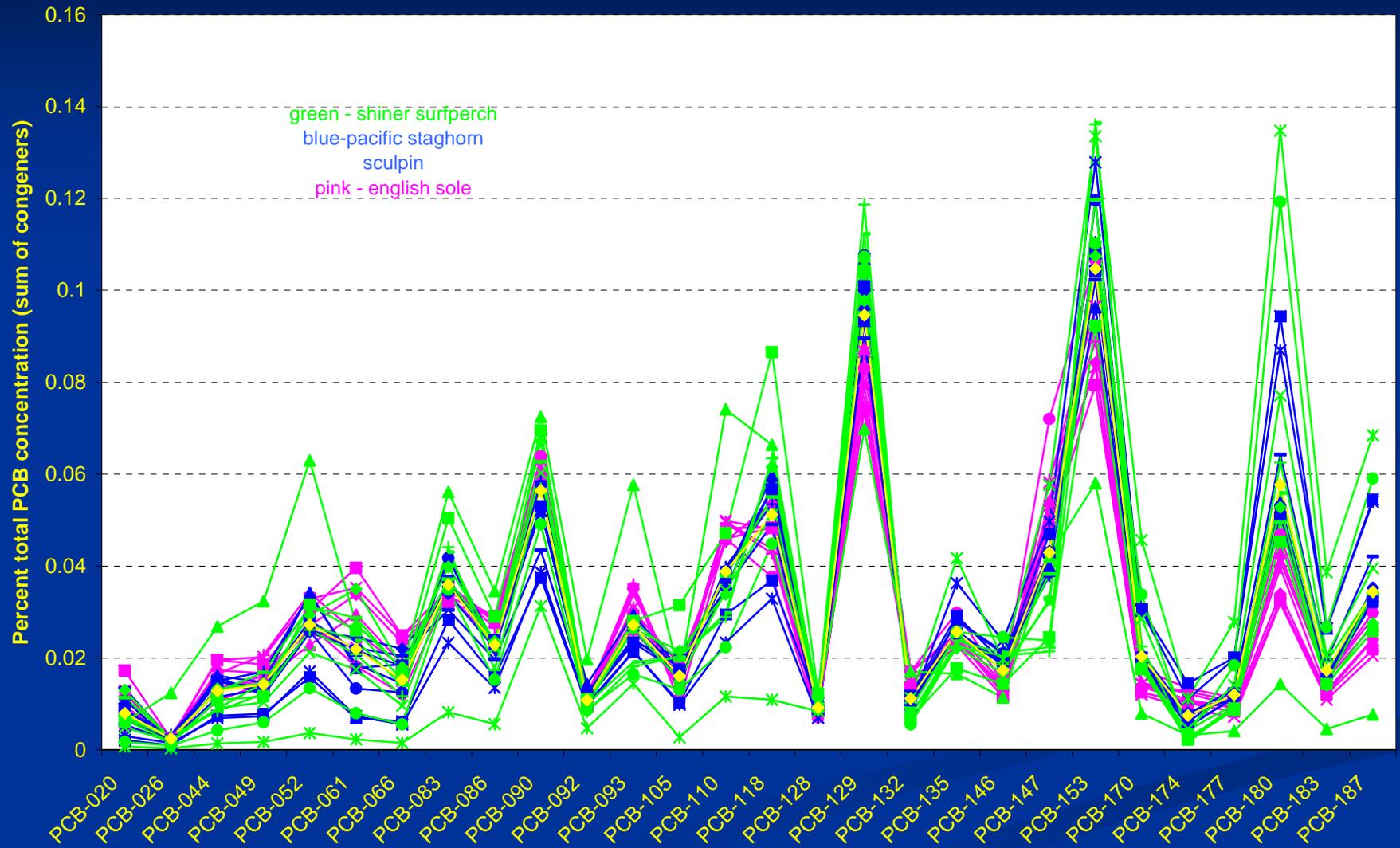
Results – Aroclor composition

- The contribution of each Aroclor to the total PCB concentration was calculated for each tissue sample.
 - Benthic invertebrate and clam tissue samples generally quantified as Aroclor 1254
 - 2 benthic invertebrate and 3 clam tissue samples that contained mixtures of Aroclors also had the poorest agreement between the Aroclor sums and congener sums
 - Whole body fish and crab hepatopancreas tissue samples generally quantified as approximately 20% Aroclor 1248, 40% Aroclor 1254 and 40% Aroclor 1260, while crab edible meat were quantified mostly as mixtures of 50% Aroclor 1254 and 50% Aroclor 1260.

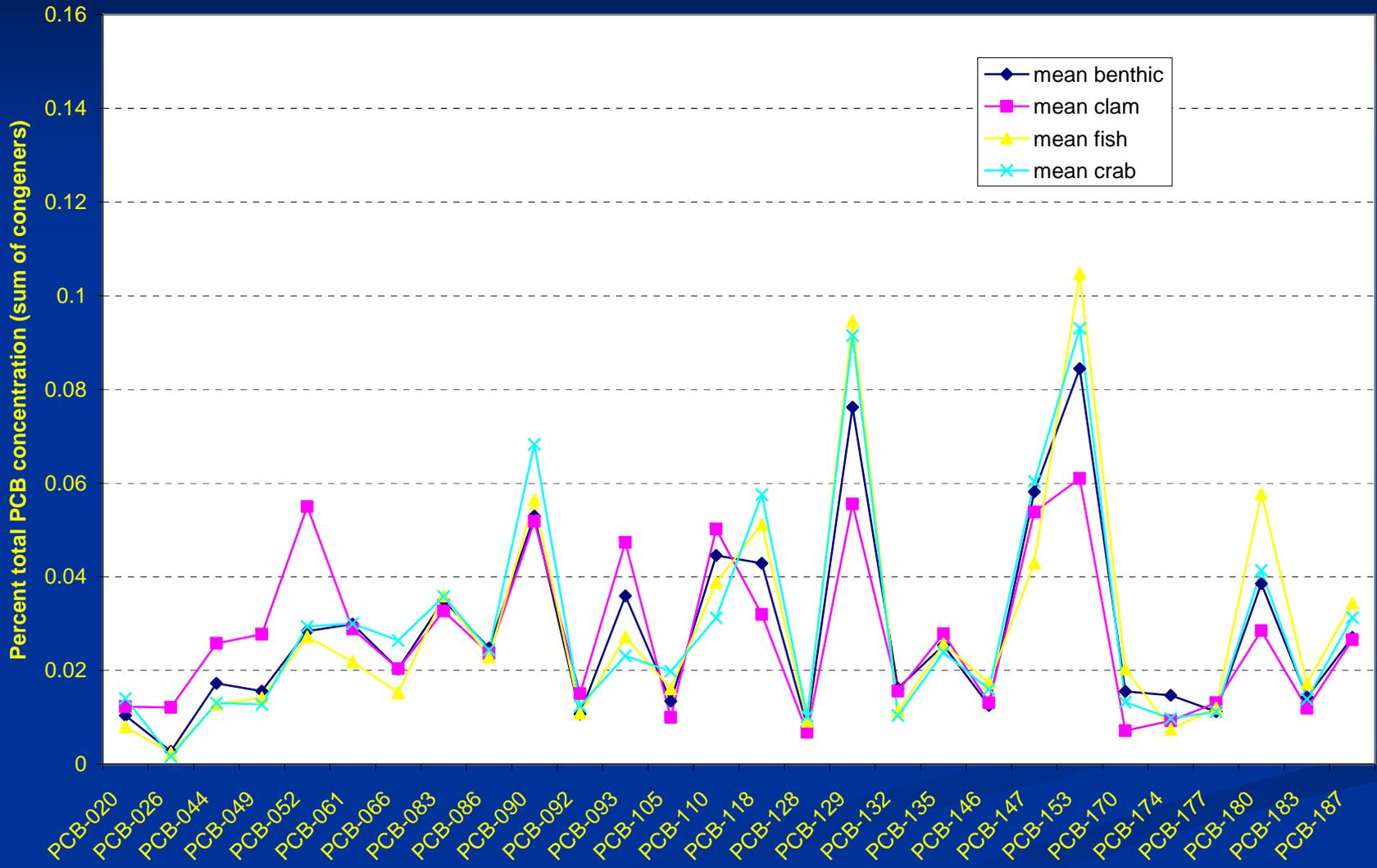
PCB Congener Patterns in Clam Tissue



PCB Congener Pattern in Whole body fish



Mean Congener Patterns in All Tissue Types



Conclusions

- For the benthic invertebrate and clam samples, the samples that had congener patterns that differed from the other samples were quantified as mixtures of Aroclors. The resulting Aroclor sums:
 - overestimated total PCBs relative to the congener sum for one benthic sample
 - underestimated total PCBs relative to the congener sums for two clam samples

Conclusions (cont)

- When patterns for mean congener concentrations were compared among all tissue types they were generally similar
- For benthic invertebrates, the Aroclor sums both under- and overestimated total PCBs relative to congener sums
- For clams, the Aroclor sums almost always underestimated total PCBs relative to congener sums

Conclusions (cont)

- For fish and crabs, the Aroclor sums always overestimated total PCBs relative to congener sums
- Total PCBs based on Aroclor sums was a conservative estimate of total PCBs; except in the case of clams but differences in risks estimates are expected to be negligible