

DEPARTMENT OF TOXIC  
SUBSTANCES CONTROL



ENVIRONMENTAL CHEMISTRY LABORATORY

**Serum Concentrations of Organochlorine Pesticides  
and PCB Congeners in Pregnant California Women,  
1959-1967**

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### Serum Concentrations of Organochlorine Pesticides and PCB Congeners in Pregnant California Women, 1959-1967

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## EXECUTIVE SUMMARY

Lipophilic contaminants such as polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) accumulate in human fatty tissues where they persist long after exposures occurred. Most of these compounds are now banned in the US, and body burdens are lower than what they used to be a few decades ago.

We analyzed 420 archived serum samples obtained from San Francisco Bay Area pregnant women participating in the Child Health and Development Studies (CHDS) between 1959 and 1967, a period of unrestricted use of PCBs and OCPs. Maternal demographic data were obtained through CHDS from medical records and prenatal interviews. Serum samples were analyzed by dual column gas chromatography with electron capture detection.

All samples had measurable levels of p,p'-dichlorodipenyldichloroethylene (p,p'-DDE), p,p'-dichlorodiphenyltrichloroethane (p,p'-DDT),  $\beta$ -hexachlorocyclohexane ( $\beta$ -HCH), hexachlorobenzene (HCB), trans-nonachlor, oxychlorane and ten PCB congeners. The most prevalent contaminants were p,p'-DDE, p,p'-DDT,  $\beta$ -HCH and PCB-153 with median values of 5120, 1360, 177 and 72 ng/g lipid, respectively. We found strong and significant correlations among many contaminants. PCB-153 represented 20% of the measurable PCB congeners and could be used to express Total PCBs. With few exceptions, our findings are consistent with measurements in similar historic populations, and are much higher than measurements from present-day US women. Temporal trends were discernible, with decreasing DDT and increasing PCBs.

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## ACRONYMS AND ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
CECBP	California Environmental Contaminant Biomonitoring Program
CHDS	Child Health and Development Studies
CPP	Collaborative Perinatal Project
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatography/Mass Spectrometry
GPC	Gel Permeation Chromatography
HCB	Hexachlorobenzene
β-HCH	β-Hexachlorocyclohexane
NHANES	National Health and Nutrition Examination Survey
NHATS	National Human Adipose Tissue Survey
OCPs	Organochlorine Pesticides
PCBs	Polychlorinated Biphenyls

## ACKNOWLEDGMENT

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## SCOPE

Human serum, milk, and adipose tissues have been used successfully to monitor body burdens of organohalogen chemicals, and surveys of targeted populations with consistent protocols have enabled researchers to examine spatial and temporal trends. In the US, the Centers for Disease Control and Prevention (CDC) provide nationwide measurements of selected organochlorine pesticides, among other analytes. The CDC database, however, does not provide state-specific information. Additionally, given the high diversity in terms of racial and ethnic composition, California's population is too complex to be characterized by national averages and requires focused studies. The recently established California Environmental Contaminant Biomonitoring Program (CECBP) is charged with assessing body burdens of several chemical contaminants statewide. Meanwhile, studies of archived serum samples from California populations reveal body burdens at the time of collection, thus providing a baseline to compare contemporary levels to be measured in future CECBP studies.

## INTRODUCTION

Organochlorine pesticides (OCPs) have been used throughout the world in agriculture, as well as in structural and vector control. Concerns about health effects and ecosystem damage led to restrictions and the eventual ban for most OCPs in the United States during the late 1970s and 1980s. Long after their use was discontinued, however, their residues persist in the food web and in human tissues (Kutz 1991, Robinson et al. 1990, CDC 2003). Polychlorinated biphenyls (PCBs) were used widely as dielectric fluids in transformers and capacitors, as lubricants, plasticizers, flame retardants and adhesives. Their production and use in the United States peaked in the 1970s until they were banned in 1977. Similar to OCPs, PCBs are persistent in the environment, are resistant to metabolism, tend to accumulate in lipids and have the potential to bioconcentrate (Robinson et al. 1990, Robertson and Hansen 2003; CDC 2003). With the exception of occupational and accidental exposures, the main exposure pathway is diet, particularly ingestion of fatty fish, meat and dairy products (Longnecker et al. 1997). Concentrations of most OCPs and PCBs in human tissues peaked in the late 1970s to the early 1980s in the industrialized world, with a steady decline observed since then (Kutz 1991, Noren and Meironyte 2000).

Many OCPs and PCBs are known endocrine disrupters. Observational and experimental research documented the direct estrogenic or anti-androgenic potential of some of the dichlorodiphenyltrichloroethane (DDT) analogues (Johnson et al. 1992; Nelson et al. 1978). Experimental evidence also demonstrated the estrogenic properties of other chlorinated pesticides such as beta-hexachloro cyclohexane ( $\beta$ -HCH) (Coosen et al. 1989) and chlordane (Soto et al. 1992), as well as PCB-187, a persistent PCB congener (Wolff et al. 1997). In addition, some moderately persistent mono-ortho PCB congeners (PCB-74, PCB-118) have low anti-estrogenic potency (Krishnan et al. 1993; Wolff et al. 1997) while other prevalent PCB congeners (PCB-153, PCB-138) induce Cytochrome P450 which may metabolize estrogen through a different pathway (Krishnan et al. 1993).

Using archived serum from a prospective cohort study of pregnancy outcomes conducted during a time of unrestricted and high domestic use of PCBs and OCPs, we examined associations among OCPs and PCBs and between subject characteristics and serum measures. The purpose of this investigation was to examine associations among OCPs and PCBs to identify key contaminants that could be used as surrogates for the rest, optimizing resources for future biomonitoring studies. We also explored the determinants of elevated exposures in an effort to trace major exposure pathways.

## **MATERIALS AND METHODS**

### **Subjects**

Data for this study come from the Child Health and Development Studies (CHDS), a longitudinal study of over 20,000 women, their pregnancies and children born from those pregnancies in Northern California (van den Berg 1979). Participants were members of the prepaid Kaiser Foundation Health Plan, reflecting a primarily middle class, yet ethnically diverse, population with at least one employed household member. Women were followed from enrollment through pregnancy and multiple samples of serum were collected and archived. The subjects for this study were originally selected for a study of maternal serum concentrations of organochlorine contaminants and the risk of cryptorchidism and hypospadias in male offspring. The 420 subjects examined here include the mothers of 155 male infants with hypospadias or cryptorchidism who survived for two years, as well as the mothers of 265 randomly selected male controls (Bhatia et al. 2005). Maternal serum collected during the second or third trimesters of pregnancy, or post-partum, was retrieved from archived frozen samples stored at the National Cancer Institute in Frederick, Maryland.

### **Target Analytes**

The primary aim of the original case-control study was to determine whether in utero exposure to p,p'-dichlorodiphenyltrichloroethane (p,p'-DDT, a known endocrine disrupter) was related to an increased incidence of cryptorchidism or hypospadias (Bhatia et al. 2005). Because other OCPs can have endocrine disrupting effects, we included these other OCPs as well as their metabolites, in our panel of analytes. We included PCBs in our chemical panel because of the precious nature and limited volume of the specimens and at the request of the CHDS conservators. Of the chemicals listed on Table 1, only those consistently measurable above their respective reporting limits in over 90% of the samples are discussed in this report.

### **Analytical Methods**

We analyzed 440 serum samples in 45 batches (420 participant samples and 20 external quality control samples). Serum samples were received frozen from the National Cancer Institute facility and were kept below -20°C until analysis. Serum was thawed and 1 mL was pipetted into a test tube. Internal standards were added prior to denaturing the proteins with acetic acid (DTSC 2003, Rogers et al. 2004). The analytes were extracted with hexane/dichloromethane, cleaned through Florisil, eluted with hexane followed by hexane/dichloromethane and recovery standards added. Analysis was performed by gas chromatography with electron capture detection equipped with 60m DB-XLB and Rtx-5ms capillary columns. Total cholesterol and triglycerides were

determined enzymatically in small aliquots of serum and were used to calculate total lipids (Phillips et al. 1989).

### **Quality Assurance**

Each batch included nine samples, one method blank, one laboratory control (bovine serum fortified with target analytes) and one standard reference material (SRM 1589, National Institute of Standards and Technology). Laboratory controls and standard reference materials were used to evaluate background contamination, precision, accuracy and analyte recovery. In addition, external quality control samples were interspersed among the samples and were analyzed by three laboratories using CHDS specimens. These external quality control samples (whose identity was revealed at the end of the analyses) were used to assess precision within and between batches, as well as bias among laboratories.

### **Coding and Statistical Analysis**

Serum was not available at similar times of gestation for all subjects, and most samples (79.5%) were collected post-partum with no information on whether subjects were fasting. Because of the long half-lives of our analytes and evidence that serial gestational and postpartum measures for serum p,p'-DDE and PCBs are highly correlated (Longnecker et al. 1999), we treated all samples as equivalent. As our previous investigations showed no effect of body burdens on disease outcome (Bhatia et al. 2005), for this report we combined case and control groups to assess historic exposures. To compare our results with other studies, we constructed "PCB<sub>4</sub>" as the sum of the most abundant PCB congeners (PCB-153, PCB-138, PCB-180 and PCB-118). Additionally, "Total PCBs" or  $\Sigma$ PCBs were calculated as the arithmetic sum of the ten major PCB congeners shown in Table 1. With the exception of serum measurements, all data are based on medical records and interview responses abstracted by CHDS study staff and coded into a public access database (Bhatia et al. 2005). We used univariate analysis to examine the distributions of target analytes. Log-transformations (base 10) were attempted but distributions remained skewed and non-parametric techniques were employed instead.

## **RESULTS AND DISCUSSION**

### **Demographics**

Demographic characteristics of the participants are shown in Table 2. With the exception of age, parity and race (all with less than 5% missing values), there was a high proportion of missing information on maternal characteristics. For example, we did not have information on whether subjects lived on a farm before age 15 for 29% of the sample, and we did not have information on income for 26% of the sample.

### **Quality Assurance**

Based on external quality control samples, within batch precision (expressed as the intra-batch coefficient of variation) ranged from 1.1% for PCB-153 to 3.1 % for p,p'-DDE. The inter-batch coefficient of variation ranged from 3.95% for PCB 153 to 15.35% for PCB 118. Recoveries of internal standards were used to gauge overall data quality

across all serum samples. Recoveries were between 81-99% and no corrections were made to the data.

### **Contaminant Concentrations**

As shown in Table 2, p,p'-DDE was by far the most dominant contaminant, followed by p,p'-DDT and  $\beta$ -HCH. PCB-153 was the most prominent PCB congener followed by PCB-138. Contaminant distributions were skewed, particularly for hexachlorobenzene (HCB) and  $\beta$ -HCH.

### **Correlations among contaminants**

Based on Spearman correlations (data not shown), PCB congeners were strongly and significantly ( $p < 0.001$ ) correlated with each other and with the summary measures,  $\Sigma$ PCB and PCB4. The correlation coefficient between the summary measures ( $\Sigma$ PCB and PCB4) was  $r = 0.99$ , and both  $\Sigma$ PCB and PCB4 were driven by PCB-153 and PCB-138 (all  $r > 0.97$ ,  $p < 0.001$ ). The next strongest correlation coefficients ( $r > 0.8$ ) were observed between members of the same homologue groups, i.e. PCB-99, PCB-118 (penta-PCBs); PCB-138, PCB-153 (hexa-PCBs); PCB-170, PCB-180 (hepta-PCBs). Weaker ( $0.6 < r < 0.8$ ), but still significant ( $p < 0.001$ ), correlations were observed between PCB-74 (a tetra-substituted congener) and the penta-, hexa- and hepta-PCBs. Among the pesticides, oxychlorane and trans-nonachlor were the most highly correlated ( $r = 0.86$ ,  $p < 0.001$ ), followed by p,p'-DDE and p,p'-DDT ( $r = 0.65$ ,  $p < 0.001$ ). Correlation coefficients ranged between 0.2 and 0.6 for all other pesticide pairs. Weaker correlations were observed between individual PCBs and pesticides.

### **Correlations Among Chemicals-Use of Surrogates**

We examined correlations among chemicals to assess whether some could be used as surrogates for others. Strong correlations pose difficulties in attributing health effects to specific contaminants. On the other hand, strong correlations may allow (after validation) measurement of fewer chemicals, as surrogates for others, optimizing resources in future studies.

We found the strongest correlations among members of the same PCB homologue group, probably associated with similar half lives, with correlations decreasing as the difference in chlorination increased. Ten PCB congeners (tetra- to octa-chlorinated, with their sum expressed as  $\Sigma$ PCB) were prevalent in all samples reflecting exposures to a variety of Aroclor products and varying metabolic half lives. When we examined correlations among congeners, we found that the most dominant congener, PCB-153 representing a little over 20% of  $\Sigma$ PCB, had the highest Spearman correlation coefficient with  $\Sigma$ PCB, and could, therefore, be used to express total PCB exposures. One implication of this observation (also reported in studies of contemporary populations [Longnecker et al. 2003]) may be that detailed analysis of many PCB congeners may not be necessary for human exposures, but that PCB 153 (or other congeners) could be used as a surrogate for  $\Sigma$ PCB, assuming homogeneous populations (Longnecker et al. 2003). Alternatively, PCB-153 might be a good indicator for the presence of another congener whose levels may be too low to measure confidently in all subjects, but whose health effects may be of interest. Classifications of select congeners into groups based on their biologic activities (neurotoxicity, estrogenic/antiestrogenic potential, enzyme induction) and persistence have been

proposed (Wolff et al. 1997). Human specimens, however, usually contain a few measurable congeners from each of the proposed groups, limiting the applicability of these classifications. Imputation techniques based on relative profiles may help utilize these classifications.

Oxychlordane and trans-nonachlor, both metabolites of chlordane, were the only OCPs strongly correlated with each other. We found lower, but still significant, correlation between p,p'-DDT and its primary metabolite p,p'-DDE ( $r=0.65$ ,  $p<0.001$ ). Differences in exposure pathways (e.g., pesticide application, diet) among populations during the 1960's may explain both the large variations in p,p'-DDT and p,p'-DDE observed in our population and the lack of strong correlation in measures obtained from this time.

### **Temporal Trends**

The decrease in concentration of OCPs and PCBs over time is well documented. Almost three decades since DDT and PCBs were banned in the US, concentrations in serum collected as part of the National Health and Nutrition Examination Survey (NHANES) are only a fraction of the concentrations we measured in our population (CDC 2003). In 1999, the median serum p,p'-DDE level in US women was 234 ng/g lipid, more than 20 times lower than in our population. Similarly, in 1999, US women had a median trans-nonachlor level of 18.4 ng/g lipid, i.e., less than half the median (46 ng/g lipid) in our population. For other analytes of interest we cannot easily use NHANES data because most NHANES measurements were below the limit of detection and medians were not reported (CDC 2003), but the downward trends are obvious. In 1999, the 90th percentile of serum PCB-153 in US women was 79 ng/g lipid, compared to our median of 72 ng/g lipid, with African-Americans continuing to have higher levels than non-Hispanic Whites. Similarly, the 75th percentile for serum  $\beta$ -HCH in US women in 1999 was 22 ng/g lipid compared to our median of 177 ng/g lipid. Consistent with our findings, Whites appeared to have higher serum  $\beta$ -HCH levels than African-Americans. No detectable levels of HCB were reported in 1999.

Additional evidence for declining body burdens of chemical contaminants is offered by the National Human Adipose Tissue Survey (NHATS, 1970-1983): levels of  $\beta$ -HCH and PCBs started decreasing during that period, while no trend was evident for levels of HCB (Robinson et al. 1990). Not only have body burdens decreased over time, but the relative pattern of contaminants has changed as well. Because of differences in their half-lives, the ratio of p,p'-DDT to p,p'-DDE (its major metabolite) is often used to assess recent exposures to DDT. A p,p'-DDE/p,p'-DDT ratio greater than 10 is indicative of exposures through the diet, while smaller ratios reflect direct contact with DDT. In our population, the median p,p'-DDE/p,p'-DDT ratio was 3.7 while, in contrast, the median ratio was 19 in a group of San Francisco Bay Area women sampled in the 1990s (Petreas et al. 2000). Similarly, PCB-118 concentrations fell from third rank among the PCBs measured in this 1960s cohort, to fourth rank in the 1990s group of San Francisco Bay Area women (Petreas et al. 2000). PCB-118, a penta-chlorinated congener with dioxin-like activity, has a shorter half-life than the more persistent hexa- and hepta-chlorinated congeners and its contribution to contemporary body burdens is declining.

## **Lipids**

As all target contaminants are lipophilic, concentrations increased with lipid content. There was a statistically significant increase in triglycerides among samples collected during the 2nd or 3rd trimester, and a significant decrease in those sampled postpartum (data not shown). Between-trimester differences in cholesterol were not statistically significant and neither were the calculated values for Total Lipids based on triglycerides and cholesterol. Increases in serum lipids have been observed during pregnancy, however, (Chiang et al. 1995; Longnecker et al. 1999) and thus lipid-adjusted measurements should be used for comparisons to other studies, particularly if there were no fasting requirements.

## **Comparison to Similar Populations**

The concentrations of contaminants in this population were lower than those reported from another CHDS study on neurobehavioral effects (James et al. 2002). Possible explanations for the differences may be differences in the recruitment period and the population selection criteria. Our recruitment period was from 1959 to 1966, while that study (James et al. 2002) collected samples between 1963 and 1967. As all exposures were still increasing (based on increased production/use) the James group was expected to have higher body burdens. In fact, James et al. reported increasing PCB levels with calendar year, consistent with increasing exposures from 1963 to 1967 (James et al. 2002). Additionally, cognitive-impaired offspring were oversampled in the James study. If PCB levels are associated with cognitive impairments as has been shown elsewhere (Patandin et al. 1998), higher body burdens might be expected. Most importantly, there were 41.4% African-Americans in the James study and 26.4% in our population. Similar to our findings, James et al. reported higher levels in non-Whites (mostly African-American), for p,p'-DDE, p,p'-DDT, and most PCBs analyzed.

The median p,p'-DDE levels measured in the Collaborative Perinatal Project (CPP, a multicenter cohort study of mothers and children) maternal serum (Longnecker et al. 2003) were lower (4,240 ng/g lipid) than those reported in any of the CHDS groups (5,878 ng/g in the James et al. and 5,119 ng/g in our study). Since the recruitment period for the CPP study was the same (1959-1966) as ours, and the percentage of African-Americans in our study was lower (26.4%) than in the CPP (47%), one might expect the opposite observation, based on our findings on race and time. Other factors, however, including regional differences may be offsetting the impact of race and time. In contrast to the p,p'-DDE levels, median levels of PCB-153 measured in our study were lower (72 ng/g lipid) than those in the CPP samples (140 ng/g lipid) (Longnecker et al. 2003). Data from NHATS (1970-1983) and NHANES II (1976-1980) showed that Western states had the lowest PCB levels while Northeastern states had the highest, and that PCB levels were higher in non-Whites than in Whites (Robinson et al. 1990). Both geographic and racial differences may explain some of the differences we observed in PCB-153 between our population and the CPP.

This study expands the panel of contaminants measured in similar historic cohorts by providing data on additional OCPs (HCB,  $\beta$ -HCH, trans-nonachlor and oxychlorane) and prevalent PCB congeners spanning tetra- to octa-substituted homologue groups. At the same time, these data add to the body of estimates for distributions of the better

studied contaminants such as p,p'-DDT, p,p'-DDE and certain PCB congeners. Data presented in this report were used to evaluate associations between maternal DDT and DDE with birth weight and length of gestation (Farhang et al. 2005), and associations between maternal Organochlorine Pesticides and male genital anomalies (Bhatia et al. 2005).

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Table 1. Target analytes, reporting limits and percentage of samples above reporting limits<sup>a</sup>, in 420 women

	Reporting Limit (ng/mL serum)	Percent of samples above Reporting Limit
<b>PCB 74</b>	<b>0.08</b>	<b>100.0</b>
<b>PCB 99</b>	<b>0.08</b>	<b>100.0</b>
PCB 105	0.08	80.4
PCB 110	0.08	4.1
<b>PCB 118</b>	<b>0.08</b>	<b>100.0</b>
PCB 137	0.08	7.5
<b>PCB 138</b>	<b>0.08</b>	<b>99.8</b>
PCB 146	0.08	47.5
<b>PCB 153</b>	<b>0.08</b>	<b>100.0</b>
PCB 156	0.08	52.0
PCB 157	0.08	3.4
<b>PCB 170</b>	<b>0.08</b>	<b>95.0</b>
PCB 177	0.08	16.1
<b>PCB 180</b>	<b>0.08</b>	<b>99.7</b>
PCB 183	0.08	48.9
<b>PCB 187</b>	<b>0.08</b>	<b>92.0</b>
PCB 189	0.08	1.0
<b>PCB 194</b>	<b>0.08</b>	<b>97.1</b>
PCB 199	0.08	77.5
<b>PCB 203</b>	<b>0.08</b>	<b>93.6</b>
o,p -DDT	0.8	21.8
p,p' -DDD	0.8	5.2
<b>p,p' -DDE</b>	<b>3.0</b>	<b>100.0</b>
<b>p,p' -DDT</b>	<b>0.8</b>	<b>100.0</b>
<b>β-HCH</b>	<b>0.8</b>	<b>99.8</b>
<b>HCB</b>	<b>0.8</b>	<b>99.8</b>
<b>Oxychlorane</b>	<b>0.2</b>	<b>100.0</b>
<b>trans-nonachlor</b>	<b>0.8</b>	<b>100.0</b>
BDE 47	0.2	0.0
BDE 99	0.2	0.0
BDE 153	0.2	0.0

<sup>a</sup> Bold face indicates analytes measured in more than 90% of the samples.

Table 2. Characteristics of 420 pregnant women

	N	%
<b>Race</b>		
White	267	63.6
African American	111	26.4
Other <sup>a</sup>	37	8.8
<b>Age</b>		
15 – 20	62	14.8
21 – 25	132	31.4
26 – 30	108	25.7
31 $\geq$	113	26.9
<b>Place of Birth</b>		
California	137	32.6
SE US State	87	20.7
Other US State	108	25.7
Non-US	39	9.3
Unknown	49	11.7
<b>Parity</b>		
0	146	34.8
1-2	184	43.8
3+	88	21.0
<b>Body Mass Index</b>		
$\leq$ 18	49	11.7
19 - 24	269	64.0
25 - 29	45	10.7
$\geq$ 30	18	4.3
Unknown	39	9.3
<b>Ever lived on a farm before age 15</b>		
No	215	51.2
Yes	82	19.5
Unknown	123	29.3
<b>Occupation</b>		
Housewife	189	45.0
Factory/Household	33	7.9
Secretary/Clerical	96	22.9
Professional/Teacher/Stud.	31	7.4
Unknown	71	16.9
<b>Education</b>		
< 12th grade	76	18.1
High School/Trade School	236	56.2
College Graduate	59	14.0
Unknown	49	11.7
<b>Total Income</b>		
<\$5,000	68	16.2
\$5,000 - \$9,999	180	42.9
\$10,000 - \$14,999	63	15.0
Unknown	109	26.0

<sup>a</sup> Other = Hispanic, Asian, Other

Table 3. Summary statistics of lipid content (g/L) and contaminant concentrations in 420 serum samples (pg/mL and ng/mL lipid)

	pg/mL serum					ng/g lipid				
	mean	sd	median	10th %	90th %	mean	sd	median	10th %	90th %
Lipids	8.5	2.2	8.2	6.3	11.2	8.5	2.2	8.2	6.3	11.2
p,p'-DDE	47,538	23,074	42,555	23,995	76,103	5,794	2,994	5,119	2,862	10,018
p,p'-DDT	13,144	7,548	11,065	6,268	22,759	1,603	979	1,362	750	2,702
β-HCH	1,992	2,223	1,476	873	3,022	244	283	177	106	390
oxychlordan	463	195	431	248	770	56	23	51	30	83
t- nonachlor	377	180	342	184	619	46	23	41	24	73
HCB	455	936	306	170	592	55	120	37	20	74
PCB 153	687	390	594	355	1,130	82	43	72	44	131
PCB 138	640	379	545	330	1,056	77	42	67	41	127
PCB 118	520	374	439	270	823	62	42	53	33	95
PCB 180	480	253	428	265	750	58	29	51	31	89
PCB 99	236	155	202	122	366	28	18	24	16	43
PCB 74	205	122	181	100	329	24	13	21	13	38
PCB 170	159	87	140	85	257	19	10	17	11	30
PCB 187	164	96	143	83	267	20	11	17	10	31
PCB 203	98	53	89	50	154	12	6	11	6	18
PCB 194	106	53	97	56	161	13	6	12	7	19
ΣPCB	3,294	1,678	2,920	1,807	5,243	395	187	350	228	623
PCB <sub>4</sub>	2,326	1,252	2,039	1,256	3,739	279	139	245	158	449