# Chemical Burdens in Fish from Sequoia and Kings Canyon National Park

*Compared to Human and Wildlife Health Consumption Thresholds*


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## Introduction

This report is an addendum to the paper Contaminants of Emerging Concern in Fish from Western U.S. and Alaskan National Parks – Comparisons to Contaminant Health Thresholds (Flanagan *et al*. In Review) with specific focus on contaminants in fish from Sequoia and Kings Canyon National Park (NP).

The importance of monitoring contaminants in fish has been discussed previously in Flanagan *et al*. (In Review). In brief, semi-volatile organic compounds (SOCs) including pesticides, industrial by-products such as polychlorinated biphenyls (PCBs), and combustion by-products like polycyclic aromatic hydrocarbons (PAHs) may negatively impact human and wildlife health. SOCs are known to persist in the environment, bioaccumulate in food chains, and cause reproductive abnormalities, cancer, or chronic disease (Ackerman *et al.* 2008, Schwindt *et al.* 2009). Some pesticides (DDTs, chlordanes, and endosulfans) and PCBs are endocrine disruptors causing impairment to the reproductive system and other bodily functions (Schwindt *et al.* 2009).

SOCs are deposited to terrestrial ecosystems from the atmosphere in cold, high elevation and high-latitude sites. SOCs in fish were measured at national parks in the western U.S. and Alaska during WACAP. These results were compared with human and wildlife thresholds and some SOCs exceeded these limits in some fish (Ackerman *et al.* 2008, Landers *et al.* 2008, Landers *et al.* 2010, Schwindt *et al.* 2009). This report summarizes the contaminant concentrations in fish from Sequoia and Kings Canyon NP (SEKI) collected from Bench Lake and Kern Point Lake in 2009. The concentrations are also compared to fish from Emerald Lake and Pear Lake collected in 2003-2007 during the Western Airborne Contaminants Assessment Project (WACAP) and other Californian parks including Lassen

Volcanic NP (LAVO) and Yosemite NP (YOSE). Finally, the contaminant concentrations at all these parks are compared to human and wildlife thresholds.

**Study Design**

The purpose of this study was to analyze the concentration of airborne contaminants from thirty-five fish (*Salvelinus fontinalis* (Brook Trout) and *Oncorhynchus mykiss spp.* (Rainbow Trout)) in SEKI from Bench Lake and Kern Point Lake (Table 1). The research stems from WACAP findings and was conducted to gain an understanding of fish contaminant burdens at additional lakes within SEKI. Parks included in the current study and WACAP are shown in Figure 1.

Water bodies within selected parks were remote, high elevation, and removed from anthropogenic influence (e.g., roads, latrines, developed areas) to isolate the contribution of contaminant loading by atmospheric deposition. Brook Trout (Bench Lake) and Rainbow Trout (Kern Point Lake) were selected because they were available within these lakes.

*Measurement of SOCs in Fish*

The thirty-five fish (Table 1) were analyzed for the SOCs listed in Table 2. Whole fish homogenate was prepared, extracted, and analyzed following the method described in Ackerman *et al*. 2008 for a wide-range of pesticides, PAHs, and PCBs. Pesticides included both current-use pesticides (CUPs) and historic-use pesticides (HUPs, legacy contaminants now banned in North America). These SOCs are listed in Table 2 and are the same SOCs measured in fish collected for the WACAP study, excluding polybrominated diphenyl ethers (PBDEs) (Landers *et al*. 2008; Landers *et al*. 2010). Only fish with pesticide concentrations above the estimated detection limits (consistent with Ackerman *et al.* 2008) are shown in the figures.

## Results

*SOC Concentrations in Fish by Lake*

Figure 2 shows the fish SOC concentrations by park. The pesticides that were measured in >75% of the fish samples at Bench Lake included p,p'-dichlorodiphenylethene (p,p'-DDE), hexachlorobenzene (HCB), *cis*-nonachlor, *trans*-nonachlor, dacthal, endosulfan 1 and endosulfan sulfate (Figure 1). These pesticides were also measured in >75% of the samples at Kern Point Lake, with the addition of *oxy*-chlordane, *trans*-chlordane, dieldrin, and endosulfan II. The highest pesticide concentration (in ng/g lipid) measured was p,p'-DDE with concentrations 114.2 and 152.8 ng/g lipid at Bench Lake and Kern Point Lake, respectively.

*Comparison to WACAP Fish SOC Concentrations*

Figure 3A-M show the fish pesticide concentrations in ng/g lipid measured in this study (Bench Lake and Kern Point Lake in SEKI), along with the fish pesticide concentrations measured in WACAP (Pear Lake and Emerald Lake in SEKI) (Ackerman *et al*. 2008, Landers et al 2008; Figure 1), Summit Lake in LAVO, and Mildred Lake in YOSE. Figure 4A-L shows the fish pesticide concentrations for these same lakes in ng/g wet weight (ww). In general, the pesticide profiles are the same for each site for both ng/g lipid and ng/g ww. To compare SOC concentrations in fish from the current study to WACAP, concentrations in ng/g lipid were used. Normalizing concentrations by lipid content of individual fish helps to account for differences in size and species between all of the fish.

Concentrations (ng/g lipid) for the individual pesticides, individual PCBs, total endosulfans (termed "endosulfans" - sum of endosulfan I, II and sulfate), total chlordanes (termed "chlordanes" - sum of *oxy*-, *cis*,-, *trans*-chlordane, *cis*-, *trans*-nonachlor), and total

PCBs (termed PCBs – sum of PCB 101, 118, 138, 153, 183, and 187) were statistical similar at Bench Lake and Kern Point Lake (p-value < 0.05). One fish from Bench Lake, BL 10, had a cis-chlordane concentration that was significantly higher than the fish concentrations at Kern Point (Figure 2). Fish dacthal, endosulfan sulfate, endosulfans, dieldrin, pp-DDE, individual PCBs and total PCBs concentrations from Bench Lake and Kern Point Lake were statistically lower than the fish concentrations for the same SOCs from Pear Lake and Emerald Lake (p-value < 0.05) . The fish concentrations of all other SOCs were similar at all four SEKI lakes. g-HCH and a-HCH were not detected in fish from Bench Lake or Kern Point Lake but were detected in fish from Pear Lake and Emerald Lake. Mirex and methoxychlor were not detected in fish from Bench Lake but were detected at Kern Point Lake. SOC concentrations in fish from Bench Lake and Kern Point Lake from SEKI were similar to, or less than, the SOC concentrations in fish from Summit Lake in LAVO and Mildred Lake in YOSE.

*Comparison of Fish SOC Concentrations to Human Health Thresholds*

Similar to Ackerman *et al*. 2008, contaminant health thresholds for humans were adopted from the U.S. Environmental Protection Agency (EPA) to evaluate non-cancer and cancer contaminant health thresholds for recreational or subsistence fish consumption. These data are shown in Figure 4 and Tables 3 (subsistence fish consumption only). No fish SOC concentration in Bench Lake or Kern Point Lake exceeded the threshold for recreational fish consumption. Dieldrin concentrations in one individual fish out of 17 fish (BL 10) from Bench Lake and 12 out of 18 fish from Kern Point Lake exceeded the subsistence fish consumption threshold. Concentration of p,p'-DDE in one individual fish out of 18 fish from Kern Point Lake exceeded the threshold for subsistence fish consumption.

*Comparison of Fish SOC Concentrations to Wildlife Health Thresholds*

Similar to Ackerman *et al*. 2008, contaminant health thresholds for piscivorous wildlife (kingfisher, mink, and river otter) were derived from EPA nonlethal reproductive and developmental wildlife health end points as indicators of a negative effect. The data for chlordanes, dieldrin, and p,p'-DDE are shown in Figure 5 and Table 4. No individual fish from Bench Lake or Kern Point Lake exceeded the chlordanes or dieldrin wildlife thresholds (Figure 5). However, one individual fish from Kern Point Lake exceeded the p,p'-DDE threshold for kingfisher. This is a lower frequency of exceedences than Pear Lake (2 out of 10), Emerald Lake (3 out of 10), and Mildred Lake in YOSE (4 out of 10). Established wildlife contaminant health thresholds for the remaining historic-use pesticides and for the current-use pesticides have not been developed.

Figure 1. Fish from national parks analyzed for SOC concentrations by the Simonich Lab: WACAP and current study. WACAP fish samples were collected in 2003–2006. Fish samples analyzed in the current study were collected in 2005–2006 and 2008–2009.

Table 1. Fish collected at Bench Lake and Kern Point Lake in SEKI in 2009.

| Sample Name* | Waterbody/Lake | Species | Length (mm) |
|---|---|---|---|
| BL 1 | Bench Lake | brook trout | 125 |
| BL 2 | Bench Lake | brook trout | 182 |
| BL 6 | Bench Lake | brook trout | 101 |
| BL 8 | Bench Lake | brook trout | 150 |
| BL 9 | Bench Lake | brook trout | 154 |
| BL 10 | Bench Lake | brook trout | 154 |
| BL 11 | Bench Lake | brook trout | 128 |
| BL 13 | Bench Lake | brook trout | 178 |
| BL 14 | Bench Lake | brook trout | 165 |
| BL 16 | Bench Lake | brook trout | 148 |
| BL 19 | Bench Lake | brook trout | 104 |
| BL 21 | Bench Lake | brook trout | 166 |
| BL 23 | Bench Lake | brook trout | 165 |
| BL 24 | Bench Lake | brook trout | 148 |
| BL 26 | Bench Lake | brook trout | 145 |
| BL 28 | Bench Lake | brook trout | 120 |
| BL 29 | Bench Lake | brook trout | 110 |
| KP 3 | Kern Point Lake | rainbow trout hybrid | 191 |
| KP 5 | Kern Point Lake | rainbow trout hybrid | 123 |
| KP 6 | Kern Point Lake | rainbow trout hybrid | 154 |
| KP 7 | Kern Point Lake | rainbow trout hybrid | 195 |
| KP 8 | Kern Point Lake | rainbow trout hybrid | 202 |
| KP 9 | Kern Point Lake | rainbow trout hybrid | 217 |
| KP 11 | Kern Point Lake | rainbow trout hybrid | na |
| KP 12 | Kern Point Lake | rainbow trout hybrid | 234 |
| KP 15 | Kern Point Lake | rainbow trout hybrid | 155 |
| KP 16 | Kern Point Lake | rainbow trout hybrid | 189 |
| KP 17 | Kern Point Lake | rainbow trout hybrid | 133 |
| KP 21 | Kern Point Lake | rainbow trout hybrid | 268 |
| KP 22 | Kern Point Lake | rainbow trout hybrid | 226 |
| KP 23 | Kern Point Lake | rainbow trout hybrid | 238 |
| KP 25 | Kern Point Lake | rainbow trout hybrid | 260 |
| KP 26 | Kern Point Lake | rainbow trout hybrid | 153 |
| KP 27 | Kern Point Lake | rainbow trout hybrid | 179 |
| KP 31 | Kern Point Lake | rainbow trout hybrid | 215 |

*An additional fish was collected at Bench Lake, BL3, but the data was not included in this report because of poor surrogate recoveries caused by matrix interferences.

Table 2. SOCs measured in fish by GC/MS using two modes of ionization.

| **Electron Impact Ionization** | **Negative Chemical Ionization** |
|---|---|
| Pesticides and degradation products: o,p'-DDT, p,p'-DDT, o,p'-DDD, p,p'-DDD, o,p'-DDE, p,p'-DDE, Methoxychlor, Acetochlor | Pesticides and degradation products: Hexachlorocyclohexanes (HCH) ($\alpha$, $\beta$, $\gamma$, $\delta$) Chlordanes[2] (cis, trans, oxy), Nonachlor (cis, trans), Heptachlor, Heptachlor Epoxide, Endosulfans[3] (I, II, and sulfate), Dieldrin, Aldrin, Endrin, Endrin Aldehyde, Hexachlorobenzene (HCB), Dacthal, Chlorpyrifos, Chlorpyrifos oxon, Trifluralin, Metribuzin, Triallate, Mirex |
| PAHs[1]: Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Retene, Benz[a]anthracene, Chrysene, Triphenylene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[e]pyrene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, Dibenz[a,h]anthracene, Benzo[ghi]perylene | PCBs[4]: PCB 74, PCB 101, PCB 118, PCB 138, PCB 153, PCB 183, and PCB 187 |
| Surrogates: $d_{10}$-Fluorene, $d_{10}$-Phenanthrene, $d_{10}$-Pyrene, $d_{12}$-Triphenylene, $d_{12}$-Benzo[a]pyrene, $d_{12}$-Benzo[ghi]perylene, $d_8$-p,p'-DDE, $d_8$-p,p'-DDT, $d_6$-Methyl Parathion, | Surrogates: $^{13}C_{12}$ PCB 101 (2,2',4,5,5'-Pentachlorobiphenyl), $^{13}C_{12}$ PCB 180 (2,2', 3,4,4',5,5'-Heptachlorobiphenyl), $d_{10}$ -Chlorpyrifos, $^{13}C_6$-HCB, $d_6$-$\gamma$-HCH, $d_4$-Endosulfan I, $d_4$-Endosulfan II |
| Internal Standards: $d_{10}$-Acenaphthene, $d_{10}$-Fluoranthene, $d_{12}$-Benzo[k]fluoranthene | Internal Standards: $d_{14}$-Trifluralin |

[1] ΣPAHs= Chrysene+ Triphenylene+ Fluorene+ Phenanthrene+ Anthracene+ Fluoranthene+ Pyrene+ Retene+ Benz[a]anthracene+ Benzo[b]fluoranthene+ Benzo[k]fluoranthene+ Benzo[e]pyrene+ Benzo[a]pyrene+ Indeno[1,2,3-cd]pyrene+ Dibenz[a,h]anthracene+ Benzo[ghi]perylene

[2] Σchlordanes= *oxy*-chlordane+ *trans*-chlordane+ *cis*-chlordane+ *cis*-nonachlor+ *trans*-nonachlor

[3] Σendosulfans= endosulfan I+ endosulfan II+ endosulfan sulfate

[4] ΣPCBs= PCBs 101+ 118+ 138+ 153+ 183+ 187

Figure 2. Mean SOC concentrations in fish (ng/g lipid) for Bench Lake and Kern Point Lake. Bars represent standard error.

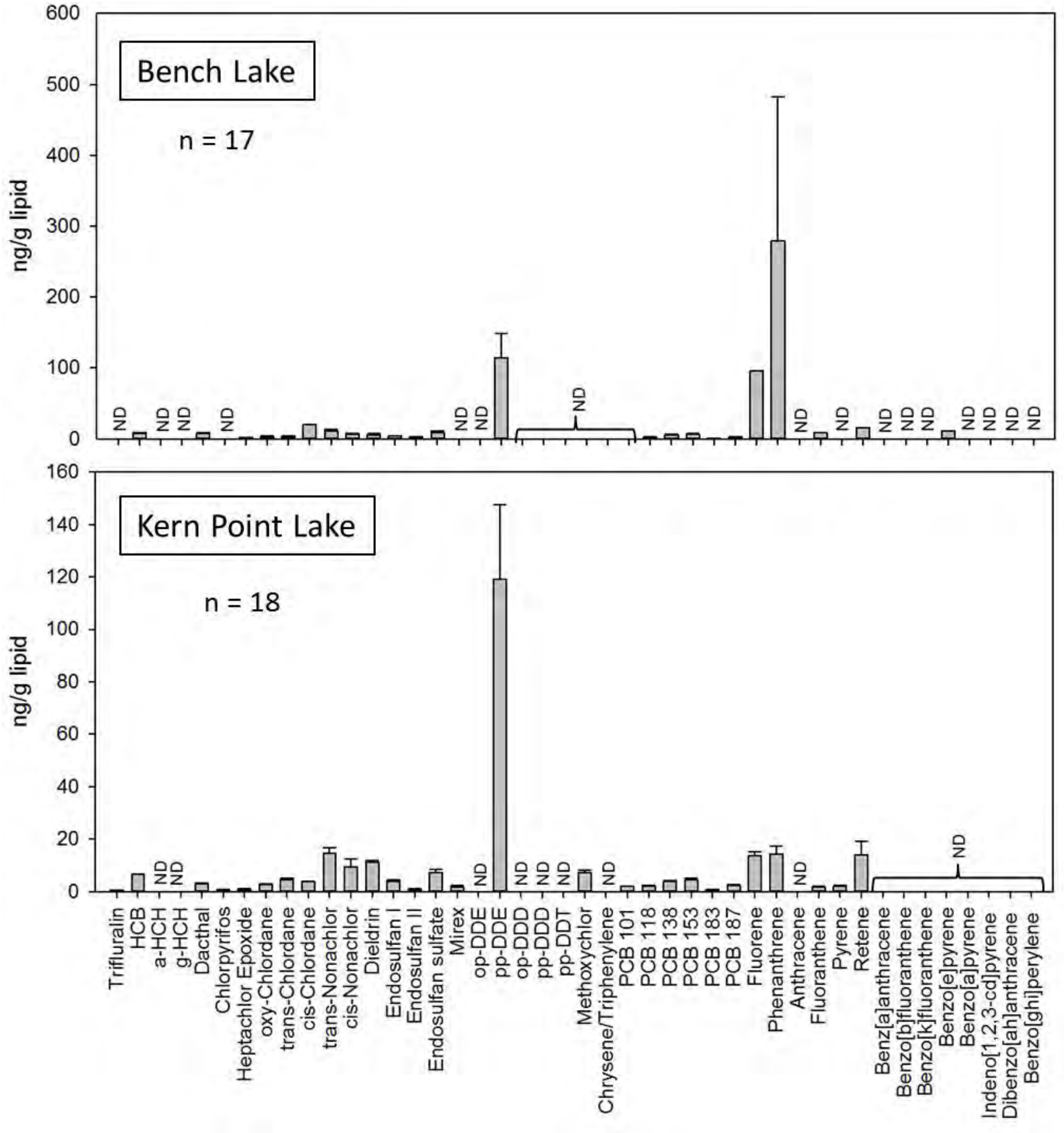


Figure 3 (A-M). Concentrations of the top 13 SOCs of concern in fish (ng/g lipid) at Summit Lake (LAVO), Mildred Lake (YOSE), Pear Lake (SEKI), Emerald Lake (SEKI), Bench Lake (SEKI), and Kern Point Lake (SEKI). Top of bar indicates the mean concentration and the circles indicate concentrations of individual fish. Black bars depict data from current study; white bars depict previously published data from WACAP (Landers et al. 2010; Ackerman et al. 2008). ND, no detect; *, ND > 50% of lake fish.

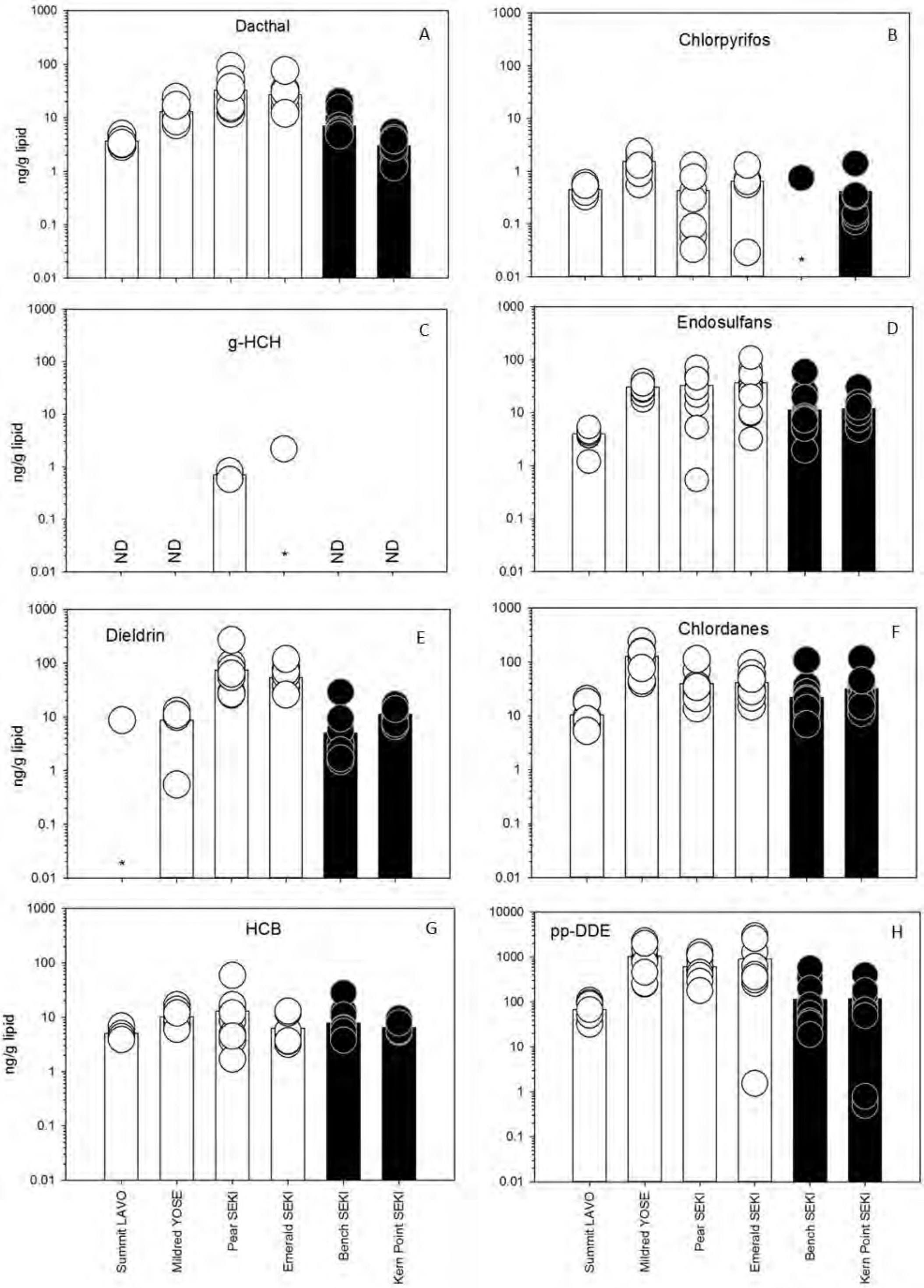


Figure 3 continued

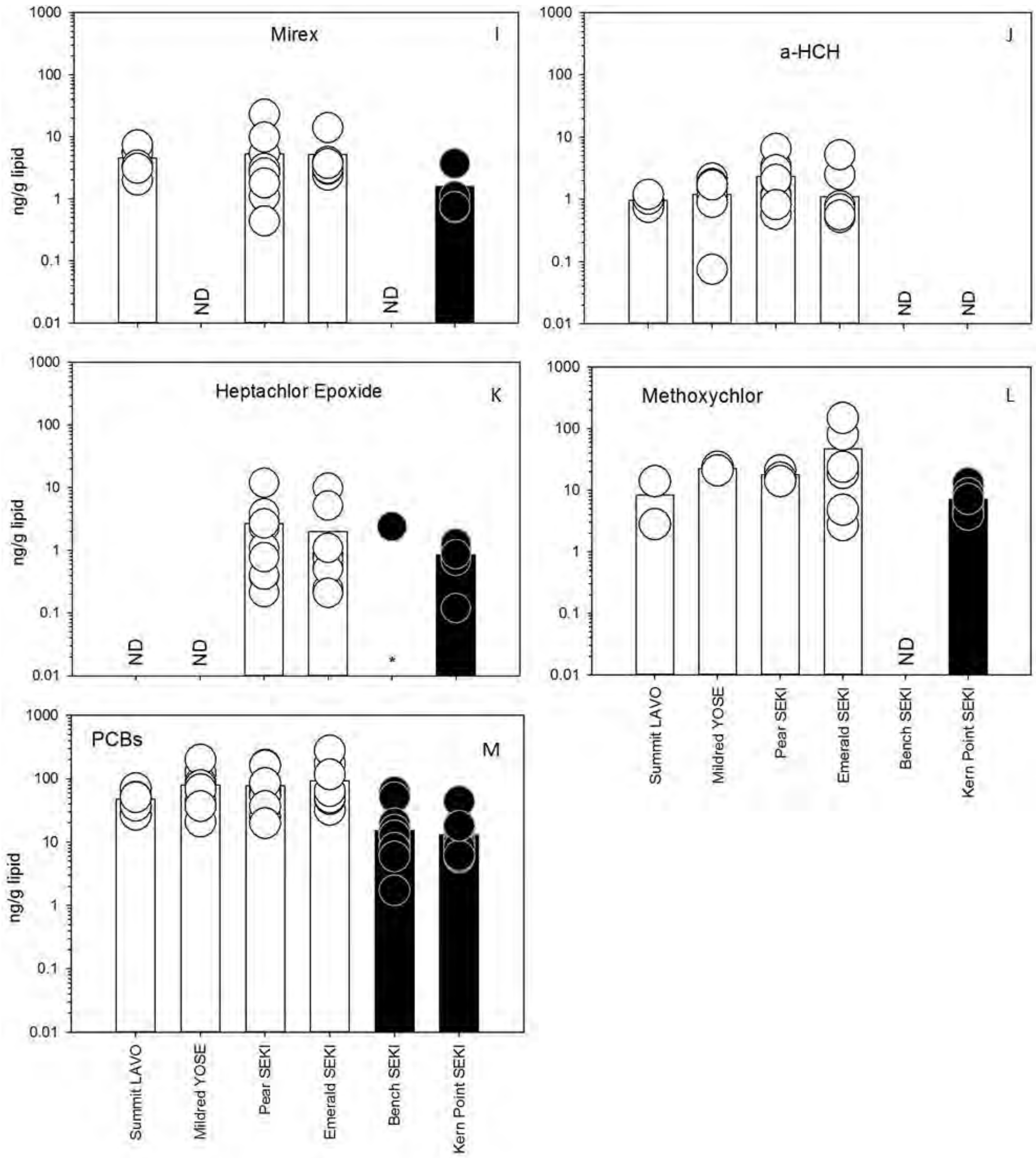


Figure 4 (A-L). Concentrations of SOCs in fish compared to human health consumption thresholds. Top of bar indicates the mean concentration and the circles represent the concentrations of individual fish. The solid line represents the threshold for recreational consumption and the dotted line represents subsistence consumption.

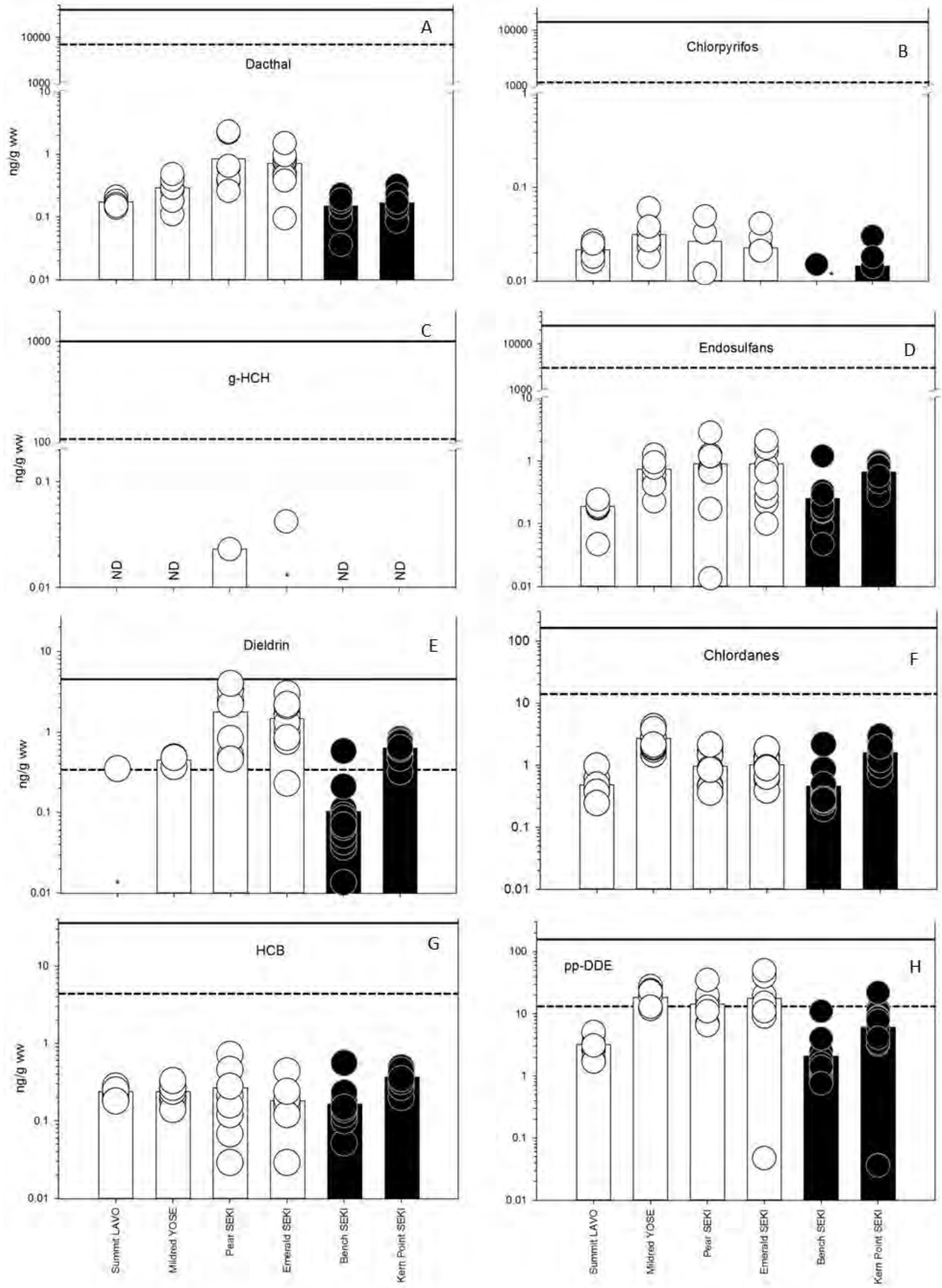
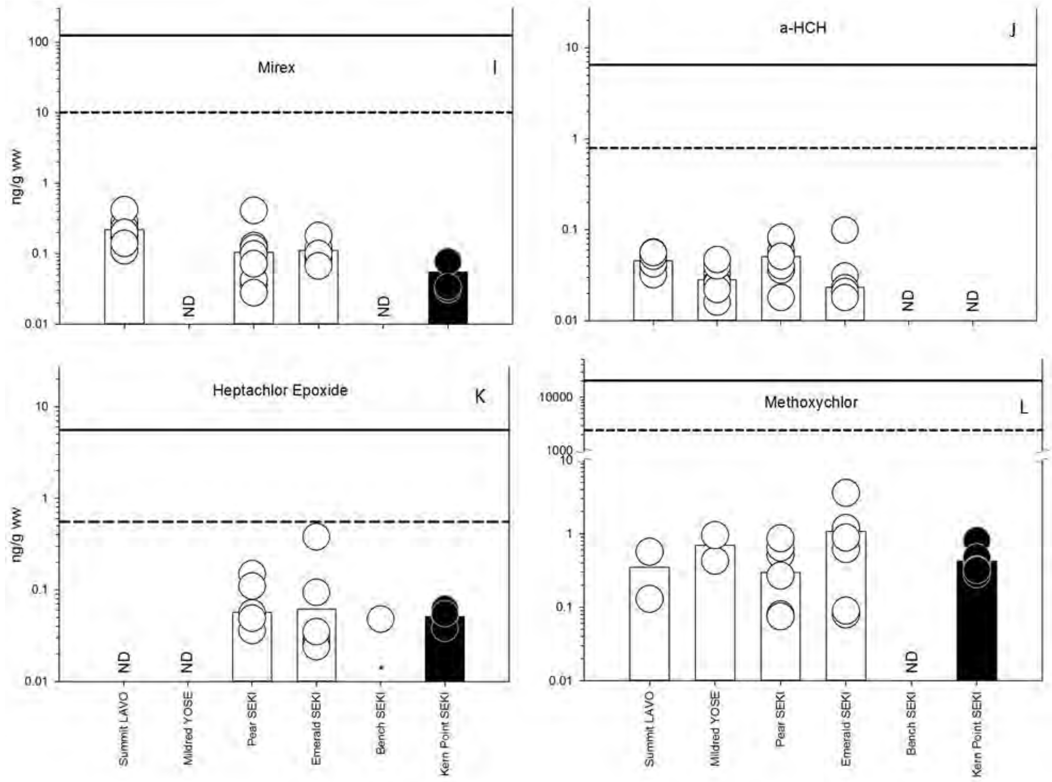


Figure 4 continued.



Figures 5A–C. Concentrations of historic-use pesticides chlordanes, *p'p*-DDE, and dieldrin in fish (ng/g ww) compared to piscivorous wildlife health thresholds for kingfisher (dotted line), mink (dashed line), and river otter (solid line). Top of bar indicates the mean concentration and the circles represent the concentrations of individual fish. Black bars depict data from current study; white bars depict previously published data from WACAP (Landers et al. 2010; Ackerman et al. 2008). ND, no detect; *, ND > 50% of lake fish.

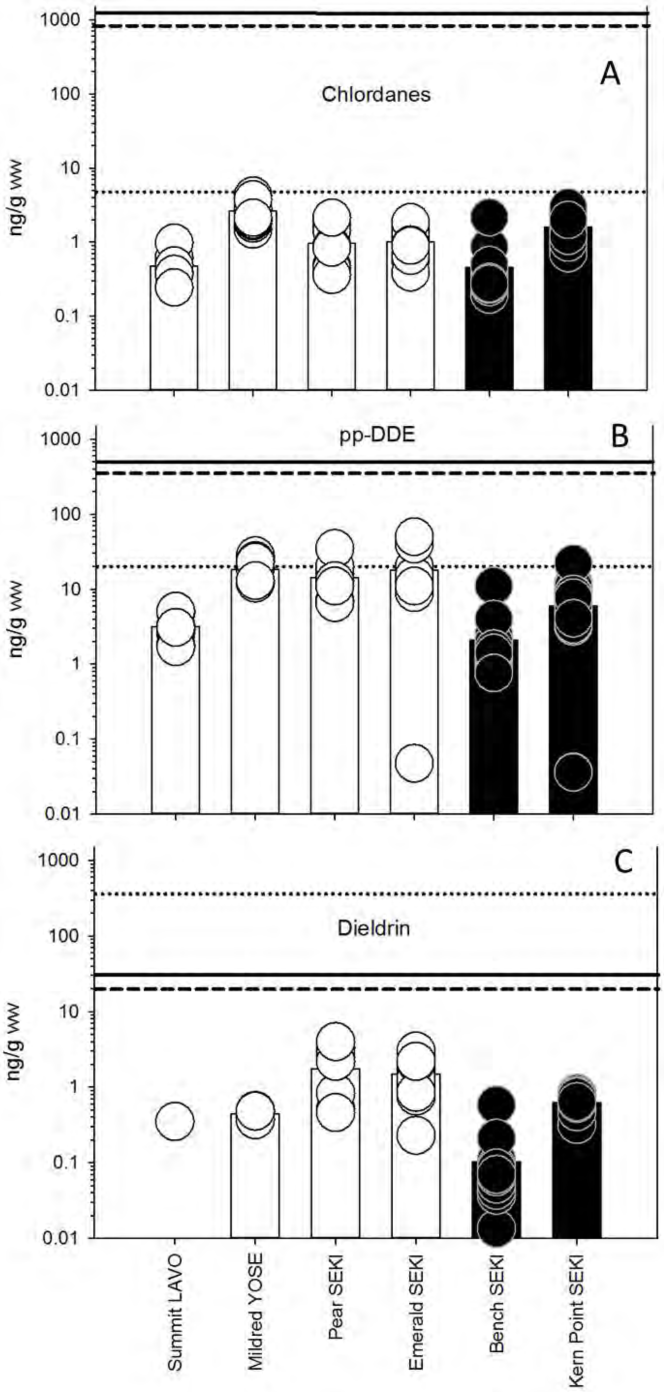


Table 3: Number of fish exceeding subsistence fish consumption threshold established for human health. Numerator indicates number of fish exceeding consumption limit and denominator indicates number of fish analyzed. Shaded cells depict an exceedance. No fish exceeded the recreational fish consumption threshold. Contaminant abbreviations as follows: DCPA, dacthal; CLPRY, chlorpyrifos; γ-HCH, gamma-hexachlorohexane; ENDO, endosulfans; DLDRN, dieldrin; CLDN, chlordanes; HCB, hexachlorobenzene; ppDDE, *p,p'*-dichlorodiphenylethene

| **Park** | **Water Body** | **SOC** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **DCPA** | **CLPYR** | **γ-HCH** | **ENDO** | **DLDRN** | **CLDN** | **HCB** | **ppDDE** |
| Sequoia & Kings Canyon | Bench | 0 / 18 | 0 / 18 | 0 / 18 | 0 / 18 | 1 / 17 | 0 / 18 | 0 / 18 | 0 / 18 |
| | Kern Point | 0 / 18 | 0 / 18 | 0 / 18 | 0 / 18 | 12 / 18 | 0 / 18 | 0 / 18 | 1 / 18 |
| | Pear | 0 / 10 | 0 / 10 | 0 / 10 | 0 / 10 | 10 / 10 | 0 / 10 | 0 / 10 | 3 / 10 |
| | Emerald | 0 / 10 | 0 / 10 | 0 / 10 | 0 / 10 | 9 / 10 | 0 / 10 | 0 / 10 | 4 / 10 |
| Lassen Volcanic | Summit | 0 / 8 | 0 / 8 | 0 / 8 | 0 / 8 | 1 / 8 | 0 / 8 | 0 / 8 | 0 / 8 |
| Yosemite | Mildred | 0 / 10 | 0 / 10 | 0 / 10 | 0 / 10 | 3 / 10 | 0 / 10 | 0 / 10 | 5 / 10 |

Table 4: Number of fish exceeding kingfisher health thresholds. Numerator indicates number of fish exceeding consumption limit and denominator indicates number of fish analyzed. Shaded cells depict an exceedance. No fish exceeded the mink or river otter health thresholds. Contaminant abbreviations: DLDRN, dieldrin; CLDN, chlordanes; ppDDE, *p,p'*-dichlorodiphenylethene

| **Park** | **Water Body** | **SOC** | | |
|---|---|---|---|---|
| | | **DLDRN** | **CLDN** | **ppDDE** |
| Sequoia & Kings Canyon | Bench | 0 / 18 | 0 / 17 | 0 / 18 |
| | Kern Point | 0 / 18 | 0 / 18 | 1 / 18 |
| | Pear | 0 / 10 | 0 / 10 | 2 / 10 |
| | Emerald | 0 / 10 | 0 / 10 | 3 / 10 |
| Lassen Volcanic | Summit | 0 / 8 | 0 / 8 | 0 / 8 |
| Yosemite | Mildred | 0 / 10 | 0 / 10 | 4 / 10 |

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# Appendix

Appendix A. SOC concentrations (ng/g wet weight) in fish. Concentrations below the detection limit are represented by half of the estimated detection limits shown in blue. Blank cells represent SOC concentrations in laboratory blanks that were at least 30% the concentration in the sample.

| Sample Name | TFLN ng/g ww | HCB ng/g ww | a-HCH ng/g ww | g-HCH ng/g ww | DCPA ng/g ww | CLPYR ng/g ww | HCLR E ng/g ww | o-CLDN ng/g ww | t-CLDN ng/g ww | c-CLDN ng/g ww | t-NCLR ng/g ww | c-NCLR ng/g ww |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BL 1 | | 0.17 | 0.0065 | 0.0095 | 0.17 | 0.00485 | 0.025 | 0.0185 | 0.00055 | 0.0435 | 0.20 | 0.12 |
| BL 2 | | 0.052 | 0.00185 | 0.00255 | 0.036 | 0.00135 | 0.007 | 0.005 | 0.0001545 | 0.012 | 0.13 | 0.065 |
| BL 6 | | 0.150 | 0.0145 | 0.0205 | 0.23 | 0.0105 | 0.055 | 0.0405 | 0.00125 | 0.095 | 0.21 | 0.095 |
| BL 8 | | 0.11 | 0.00315 | 0.0044 | 0.099 | 0.0023 | 0.012 | 0.036 | 0.000264 | 0.0205 | 0.13 | 0.13 |
| BL 9 | | 0.15 | 0.00305 | 0.0043 | 0.16 | 0.0022 | 0.0115 | 0.051 | 0.034 | 0.02 | 0.18 | 0.099 |
| BL 10 | | 0.56 | 0.00265 | 0.0037 | 0.19 | 0.015 | 0.048 | 0.16 | 0.27 | 0.40 | 0.76 | 0.57 |
| BL 11 | | 0.13 | 0.00495 | 0.007 | 0.14 | 0.0036 | 0.0185 | 0.0135 | 0.000417 | 0.0325 | 0.18 | 0.079 |
| BL 13 | | 0.1 | 0.00265 | 0.00365 | 0.093 | 0.0019 | 0.01 | 0.049 | 0.033 | 0.017 | 0.21 | 0.12 |
| BL 14 | | 0.15 | 0.00215 | 0.00295 | 0.13 | 0.00155 | 0.008 | 0.059 | 0.042 | 0.014 | 0.18 | 0.110 |
| BL 16 | | 0.12 | 0.0028 | 0.00395 | 0.10 | 0.00205 | 0.0105 | 0.008 | 0.0002355 | 0.0185 | 0.15 | 0.096 |
| BL 19 | | 0.160 | 0.0105 | 0.0145 | 0.22 | 0.0075 | 0.0395 | 0.029 | 0.0009 | 0.07 | 0.19 | 0.077 |
| BL 21 | | 0.12 | 0.00215 | 0.003 | 0.092 | | 0.008 | 0.042 | 0.025 | 0.014 | 0.16 | 0.11 |
| BL 23 | | 0.14 | 0.00155 | 0.00215 | 0.15 | 0.0011 | 0.006 | 0.073 | 0.034 | 0.01 | 0.25 | 0.090 |
| BL 24 | | 0.14 | 0.00285 | 0.00395 | 0.14 | 0.00205 | 0.0105 | 0.008 | 0.031 | 0.0185 | 0.18 | 0.091 |
| BL 26 | | 0.18 | 0.00295 | 0.00415 | 0.17 | 0.00215 | 0.011 | 0.056 | 0.044 | 0.0195 | 0.23 | 0.16 |
| BL 28 | | 0.230 | 0.0085 | 0.012 | 0.23 | 0.006 | 0.0325 | 0.0235 | 0.0007 | 0.055 | 0.17 | 0.12 |
| BL 29 | | 0.15 | 0.009 | 0.013 | 0.19 | 0.0065 | 0.0345 | 0.0255 | 0.00075 | 0.06 | 0.19 | 0.085 |
| KP 3 | | 0.49 | 0.0012 | 0.0017 | 0.21 | 0.0087 | 0.057 | 0.21 | 0.33 | 0.008 | 0.72 | 0.38 |
| KP 5 | | 0.34 | 0.0047 | 0.0065 | 0.18 | 0.0034 | 0.018 | 0.013 | 0.20 | 0.0305 | 0.47 | 0.22 |
| KP 6 | | 0.39 | 0.00195 | 0.00275 | 0.19 | 0.0014 | 0.0075 | 0.16 | 0.30 | 0.013 | 0.66 | 0.37 |
| KP 7 | | 0.44 | 0.00195 | 0.0027 | 0.16 | 0.0014 | 0.0075 | 0.22 | 0.30 | 0.0125 | 0.90 | 0.40 |
| KP 8 | | 0.37 | 0.00125 | 0.0017 | 0.32 | 0.0009 | 0.062 | 0.15 | 0.21 | 0.008 | 0.76 | 0.350 |
| KP 9 | | 0.27 | 0.00125 | 0.0017 | 0.15 | 0.0064 | 0.051 | 0.13 | 0.21 | 0.008 | 0.71 | 0.30 |
| KP 11 | | 0.360 | 0.0017 | 0.00235 | 0.17 | 0.0012 | 0.0065 | 0.22 | 0.27 | 0.011 | 0.89 | 0.41 |
| KP 12 | | 0.32 | 0.0012 | 0.0017 | 0.19 | 0.0009 | 0.038 | 0.14 | 0.26 | 0.008 | 0.92 | 0.50 |
| KP 15 | | 0.39 | 0.0023 | 0.0032 | 0.210 | 0.00165 | 0.0085 | 0.18 | 0.22 | 0.015 | 0.48 | 0.23 |
| KP 16 | | 0.37 | 0.0018 | 0.0025 | 0.14 | 0.0094 | 0.055 | 0.18 | 0.29 | 0.0115 | 0.78 | 0.38 |
| KP 17 | | 0.34 | 0.005 | 0.007 | 0.15 | 0.00375 | 0.0195 | 0.0145 | 0.16 | 0.034 | 0.35 | 0.18 |
| KP 21 | 0.012 | 0.200 | 0.00125 | 0.0017 | 0.088 | 0.03 | 0.0046 | 0.071 | 0.22 | 0.008 | 0.90 | 1.3 |
| KP 22 | 0.01 | 0.49 | 0.00125 | 0.0017 | 0.10 | 0.0009 | 0.0046 | 0.17 | 0.25 | 0.008 | 0.55 | 0.43 |
| KP 23 | | 0.44 | 0.0012 | 0.0017 | 0.084 | 0.00085 | 0.00455 | 0.11 | 0.23 | 0.26 | 1.5 | 0.84 |
| KP 25 | 0.018 | 0.27 | 0.0012 | 0.0017 | 0.14 | 0.01 | 0.058 | 0.19 | 0.27 | 0.008 | 0.97 | 0.43 |
| KP 26 | | 0.32 | 0.0028 | 0.00395 | 0.14 | 0.018 | 0.0105 | 0.15 | 0.19 | 0.0185 | 0.43 | 0.21 |
| KP 27 | | 0.45 | 0.0013 | 0.0018 | 0.23 | 0.00095 | 0.0049 | 0.21 | 0.23 | 0.0085 | 0.54 | 0.23 |
| KP 31 | | 0.35 | 0.0012 | 0.0017 | 0.17 | 0.0009 | 0.039 | 0.16 | 0.31 | 0.008 | 1.0 | 0.53 |

| Sample Name | Dieldrin ng/g ww | ENDO I ng/g ww | ENDO II ng/g ww | ENDO S ng/g ww | Mirex ng/g ww | op-DDE ng/g ww | pp-DDE ng/g ww | op-DDD ng/g ww | pp-DDD ng/g ww | pp-DDT ng/g ww | MXCLR ng/g ww | CHR/TRI ng/g ww |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BL 1 | 0.05 | 0.0042 | 0.0065 | 0.18 | 0.0065 | 0.115 | 1.3 | 0.135 | 0.31 | 0.25 | | 0.039 |
| BL 2 | 0.0135 | 0.00115 | 0.00175 | 0.047 | 0.0018 | 0.032 | 2.5 | 0.0375 | 0.085 | 0.07 | | 0.011 |
| BL 6 | 0.11 | 0.17 | 0.014 | 0.13 | 0.0145 | 0.255 | 1.1 | 0.3 | 0.7 | 0.55 | | 0.085 |
| BL 8 | 0.061 | 0.028 | 0.003 | 0.18 | 0.00305 | 0.055 | 2.0 | 0.065 | 0.145 | 0.115 | | 0.0185 |
| BL 9 | 0.093 | 0.029 | 0.0029 | 0.14 | 0.003 | 0.055 | 1.1 | 0.065 | 0.14 | 0.115 | | 0.018 |
| BL 10 | 0.58 | 0.29 | 0.061 | 0.84 | 0.0026 | 0.046 | 11 | 0.055 | 0.125 | 0.1 | | 0.0155 |
| BL 11 | 0.037 | 0.097 | 0.00475 | 0.12 | 0.00485 | 0.085 | 0.98 | 0.1 | 0.23 | 0.185 | | 0.029 |
| BL 13 | 0.053 | 0.036 | 0.0025 | 0.13 | 0.00255 | 0.0455 | 4.0 | 0.055 | 0.12 | 0.1 | | 0.0155 |
| BL 14 | 0.073 | 0.061 | 0.00205 | 0.17 | 0.0021 | 0.037 | 1.5 | 0.0435 | 0.1 | 0.08 | | 0.0125 |
| BL 16 | 0.060 | 0.029 | 0.0027 | 0.061 | 0.00275 | 0.049 | 1.4 | 0.055 | 0.13 | 0.105 | | 0.0165 |
| BL 19 | 0.08 | 0.12 | 0.01 | 0.16 | 0.0105 | 0.185 | 0.98 | 0.215 | 0.485 | 0.39 | | 0.06 |
| BL 21 | 0.043 | 0.023 | 0.00205 | 0.13 | 0.0021 | 0.037 | 1.6 | 0.0435 | 0.1 | 0.08 | | 0.0125 |
| BL 23 | 0.21 | 0.039 | 0.00145 | 0.12 | 0.0015 | 0.0265 | 1.2 | 0.0315 | 0.07 | 0.055 | | 0.009 |
| BL 24 | 0.052 | 0.033 | 0.0027 | 0.014 | 0.00275 | 0.049 | 1.4 | 0.06 | 0.13 | 0.105 | | 0.0165 |
| BL 26 | 0.085 | 0.058 | 0.00285 | 0.13 | 0.0029 | 0.05 | 1.3 | 0.06 | 0.14 | 0.11 | | 0.0175 |
| BL 28 | 0.065 | 0.06 | 0.008 | 0.27 | 0.0085 | 0.15 | 1.4 | 0.175 | 0.395 | 0.32 | | 0.05 |
| BL 29 | 0.07 | 0.082 | 0.009 | 0.21 | 0.009 | 0.16 | 0.76 | 0.19 | 0.425 | 0.34 | | 0.055 |
| KP 3 | 0.59 | 0.39 | 0.064 | 0.50 | 0.0012 | 0.0215 | 12 | 0.025 | 0.055 | 0.0455 | 0.37 | 0.007 |
| KP 5 | 0.83 | 0.39 | 0.044 | 0.56 | 0.0046 | 0.08 | 3.5 | 0.095 | 0.22 | 0.175 | | 0.0275 |
| KP 6 | 0.61 | 0.11 | 0.061 | 0.34 | 0.0019 | 0.034 | 5.4 | 0.04 | 0.09 | 0.075 | 0.81 | 0.0115 |
| KP 7 | 0.54 | 0.130 | 0.038 | 0.34 | 0.0019 | 0.0335 | 11 | 0.0395 | 0.09 | 0.07 | | 0.0115 |
| KP 8 | 0.79 | 0.07 | 0.037 | 0.25 | 0.0012 | 0.0215 | 0.0365 | 0.025 | 0.055 | 0.0455 | | 0.007 |
| KP 9 | 0.56 | 0.065 | 0.020 | 0.27 | 0.0012 | 0.0215 | 5.8 | 0.025 | 0.055 | 0.0455 | 0.41 | 0.007 |
| KP 11 | 0.61 | 0.29 | 0.032 | 0.55 | 0.00165 | 0.0295 | 8.9 | 0.0345 | 0.08 | 0.065 | | 0.01 |
| KP 12 | 0.62 | 0.094 | 0.034 | 0.15 | 0.0012 | 0.0215 | 22 | 0.025 | 0.055 | 0.0455 | 0.28 | 0.007 |
| KP 15 | 0.82 | 0.4 | 0.057 | 0.50 | 0.00225 | 0.04 | 5.5 | 0.047 | 0.105 | 0.085 | | 0.0135 |
| KP 16 | 0.55 | 0.30 | 0.038 | 0.51 | 0.00175 | 0.031 | 8.0 | 0.0365 | 0.08 | 0.065 | | 0.0105 |
| KP 17 | 0.77 | 0.12 | 0.033 | 0.41 | 0.005 | 0.09 | 3.2 | 0.105 | 0.24 | 0.195 | | 0.0305 |
| KP 21 | 0.32 | 0.05 | 0.059 | 0.52 | 0.078 | 0.0215 | 8.6 | 0.025 | 0.055 | 0.0455 | | 0.007 |
| KP 22 | 0.59 | 0.37 | 0.055 | 0.11 | 0.0012 | 0.0215 | 0.0365 | 0.025 | 0.055 | 0.0455 | 0.48 | 0.007 |
| KP 23 | 0.47 | 0.27 | 0.029 | 0.54 | 0.077 | 0.021 | 0.036 | 0.0245 | 0.055 | 0.0445 | | 0.007 |
| KP 25 | 0.74 | 0.24 | 0.033 | 0.18 | 0.031 | 0.021 | 7.7 | 0.025 | 0.055 | 0.0455 | | 0.007 |
| KP 26 | 0.62 | 0.31 | 0.039 | 0.44 | 0.00275 | 0.049 | 3.4 | 0.055 | 0.13 | 0.105 | | 0.0165 |
| KP 27 | 0.61 | 0.38 | 0.060 | 0.37 | 0.00125 | 0.0225 | 4.1 | 0.0265 | 0.06 | 0.0485 | 0.33 | 0.0075 |
| KP 31 | 0.64 | 0.25 | 0.030 | 0.29 | 0.034 | 0.021 | 0.036 | 0.0245 | 0.055 | 0.045 | 0.32 | 0.007 |

| Sample Name | PCB 101 ng/g ww | PCB 118 ng/g ww | PCB 138 ng/g ww | PCB 153 ng/g ww | PCB 183 ng/g ww | PCB 187 ng/g ww | FLO ng/g ww | PHE ng/g ww | ANT ng/g ww | FLA ng/g ww | PYR ng/g ww |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BL 1 | 0.09 | 0.007 | 0.062 | 0.071 | 0.0082 | 0.029 | | | 0.12 | | |
| BL 2 | 0.025 | 0.045 | 0.14 | 0.17 | 0.020 | 0.072 | 0.009 | | 0.033 | 0.00415 | |
| BL 6 | 0.2 | 0.0155 | 0.0095 | 0.072 | 0.0014 | 0.0016 | | | 0.26 | | |
| BL 8 | 0.043 | 0.033 | 0.095 | 0.10 | 0.014 | 0.046 | | | 0.055 | | |
| BL 9 | 0.042 | 0.037 | 0.077 | 0.095 | 0.011 | 0.039 | | | 0.055 | | |
| BL 10 | 0.036 | 0.17 | 0.29 | 0.37 | 0.046 | 0.16 | 0.0125 | | 0.047 | 0.17 | |
| BL 11 | 0.07 | 0.0055 | 0.071 | 0.066 | 0.0093 | 0.030 | | | 0.09 | | |
| BL 13 | 0.036 | 0.048 | 0.13 | 0.14 | 0.017 | 0.061 | 0.0125 | | 0.047 | | |
| BL 14 | 0.029 | 0.036 | 0.094 | 0.100 | 0.012 | 0.045 | 0.01 | 3.1 | 0.038 | 0.0048 | |
| BL 16 | 0.0385 | 0.027 | 0.08 | 0.082 | 0.011 | 0.038 | | | 0.050 | | |
| BL 19 | 0.145 | 0.011 | 0.079 | 0.075 | 0.012 | 0.031 | | 9.5000 | 0.185 | | |
| BL 21 | 0.029 | 0.034 | 0.093 | 0.10 | 0.011 | 0.043 | 0.01 | | 0.038 | | 0.0043 |
| BL 23 | 0.021 | 0.037 | 0.08 | 0.087 | 0.011 | 0.039 | 2.1 | 0.61 | 0.027 | 0.00345 | 0.0031 |
| BL 24 | 0.0385 | 0.037 | 0.1 | 0.11 | 0.013 | 0.050 | | | 0.050 | | |
| BL 26 | 0.0405 | 0.034 | 0.1 | 0.10 | 0.013 | 0.042 | | | 0.050 | | |
| BL 28 | 0.115 | 0.009 | 0.096 | 0.099 | 0.012 | 0.031 | 0.041 | | 0.15 | | |
| BL 29 | 0.125 | 0.0095 | 0.006 | 0.053 | 0.00085 | 0.017 | 0.044 | | 0.165 | | |
| KP 3 | 0.0165 | 0.14 | 0.23 | 0.26 | 0.038 | 0.12 | | | 0.022 | 0.14 | 0.11 |
| KP 5 | 0.065 | 0.063 | 0.098 | 0.13 | 0.020 | 0.059 | 0.0225 | | 0.085 | 0.25 | 0.23 |
| KP 6 | 0.0265 | 0.12 | 0.15 | 0.21 | 0.028 | 0.096 | 0.0095 | | 0.0345 | 0.00445 | |
| KP 7 | 0.0265 | 0.19 | 0.27 | 0.34 | 0.048 | 0.16 | 0.009 | | 0.034 | 0.0044 | |
| KP 8 | 0.0165 | 0.110 | 0.180 | 0.20 | 0.027 | 0.100 | 0.006 | 0.75 | 0.022 | | |
| KP 9 | 0.0165 | 0.11 | 0.17 | 0.20 | 0.030 | 0.098 | 0.006 | | 0.022 | 0.076 | |
| KP 11 | 0.023 | 0.17 | 0.28 | 0.34 | 0.050 | 0.16 | | | 0.030 | | |
| KP 12 | 0.0165 | 0.086 | 0.15 | 0.19 | 0.027 | 0.11 | 0.006 | 0.55 | 0.022 | | |
| KP 15 | 0.0315 | 0.074 | 0.13 | 0.13 | 0.018 | 0.063 | 0.011 | | 0.041 | | |
| KP 16 | 0.024 | 0.11 | 0.16 | 0.21 | 0.029 | 0.10 | 0.0085 | | 0.032 | 0.11 | 0.071 |
| KP 17 | 0.07 | 0.058 | 0.11 | 0.12 | 0.017 | 0.053 | 0.0245 | | 0.090 | | |
| KP 21 | 0.0165 | 0.15 | 0.26 | 0.32 | 0.041 | 0.18 | | | 0.022 | 0.0028 | |
| KP 22 | 0.0165 | 0.0013 | 0.19 | 0.20 | 0.028 | 0.10 | | | 0.022 | | |
| KP 23 | 0.13 | 0.031 | 0.34 | 0.38 | 0.041 | 0.23 | | 0.84 | 0.022 | 0.0027 | |
| KP 25 | 0.0165 | 0.09 | 0.2 | 0.27 | 0.046 | 0.13 | 0.5 | | 0.022 | 0.10 | 0.072 |
| KP 26 | 0.0385 | 0.074 | 0.13 | 0.14 | 0.020 | 0.066 | 0.0135 | | 0.050 | | |
| KP 27 | 0.0175 | 0.091 | 0.150 | 0.160 | 0.024 | 0.076 | | | 0.023 | 0.10 | 0.088 |
| KP 31 | 0.0165 | 0.13 | 0.23 | 0.26 | 0.036 | 0.14 | 0.69 | 1 | 0.022 | 0.16 | 0.1 |

| Sample Name | Retene ng/g ww | B[a]A ng/g ww | B[b]F ng/g ww | B[k]F ng/g ww | B[e]P ng/g ww | B[a]P ng/g ww | I[1,2,3-cd]p ng/g ww | D[ah]A ng/g ww | B[ghi]P ng/g ww |
|---|---|---|---|---|---|---|---|---|---|
| BL 1 | 0.09 | 0.055 | 0.041 | 0.047 | 0.215 | 0.0335 | 0.036 | 0.038 | 0.0125 |
| BL 2 | 0.0245 | 0.0145 | 0.0115 | 0.013 | 0.06 | 0.009 | 0.01 | 0.0105 | 0.00345 |
| BL 6 | 0.195 | 0.115 | 0.09 | 0.105 | 0.47 | 0.075 | 0.08 | 0.085 | 0.0275 |
| BL 8 | 0.0415 | 0.025 | 0.019 | 0.022 | 0.10 | 0.0155 | 0.017 | 0.018 | 0.006 |
| BL 9 | 0.0405 | 0.024 | 0.019 | 0.0215 | 0.10 | 0.0155 | 0.0165 | 0.0175 | 0.006 |
| BL 10 | 0.32 | 0.021 | 0.016 | 0.0185 | 0.085 | 0.013 | 0.0145 | 0.015 | 0.00495 |
| BL 11 | 0.065 | 0.039 | 0.0305 | 0.0345 | 0.16 | 0.025 | 0.027 | 0.028 | 0.0095 |
| BL 13 | | 0.0205 | 0.016 | 0.0185 | 0.085 | 0.013 | 0.014 | 0.015 | 0.00495 |
| BL 14 | 0.028 | 0.017 | 0.013 | 0.015 | 0.07 | 0.0105 | 0.0115 | 0.012 | 0.004 |
| BL 16 | 0.037 | 0.022 | 0.017 | 0.0195 | 0.09 | 0.014 | 0.015 | 0.016 | 0.0055 |
| BL 19 | 0.14 | 0.085 | 0.065 | 0.075 | 0.335 | 0.055 | 0.055 | 0.06 | 0.0195 |
| BL 21 | 0.0285 | 0.017 | 0.013 | 0.015 | 0.07 | 0.0105 | 0.0115 | 0.012 | 0.004 |
| BL 23 | 0.0205 | 0.012 | 0.0095 | 0.0105 | 0.23 | 0.0075 | 0.0085 | 0.0085 | 0.0029 |
| BL 24 | 0.0375 | 0.0225 | 0.0175 | 0.02 | 0.09 | 0.014 | 0.0155 | 0.016 | 0.0055 |
| BL 26 | 0.0395 | 0.0235 | 0.018 | 0.0205 | 0.095 | 0.015 | 0.016 | 0.017 | 0.0055 |
| BL 28 | 0.115 | 0.065 | 0.05 | 0.06 | 0.275 | 0.043 | 0.046 | 0.0485 | 0.016 |
| BL 29 | | 0.075 | 0.055 | 0.065 | 0.295 | 0.046 | 0.0495 | 0.05 | 0.0175 |
| KP 3 | 0.016 | 0.0095 | 0.0075 | 0.0085 | 0.039 | 0.006 | 0.0065 | 0.007 | 0.0023 |
| KP 5 | 1.1 | 0.037 | 0.029 | 0.033 | 0.15 | 0.0235 | 0.0255 | 0.027 | 0.009 |
| KP 6 | 0.41 | 0.0155 | 0.012 | 0.0135 | 0.065 | 0.01 | 0.0105 | 0.011 | 0.00365 |
| KP 7 | 0.0255 | 0.0155 | 0.012 | 0.0135 | 0.06 | 0.0095 | 0.0105 | 0.011 | 0.00365 |
| KP 8 | 0.0165 | 0.0095 | 0.0075 | 0.0085 | 0.0395 | 0.006 | 0.0065 | 0.007 | 0.0023 |
| KP 9 | 0.48 | 0.0095 | 0.0075 | 0.0085 | 0.0395 | 0.006 | 0.0065 | 0.007 | 0.0023 |
| KP 11 | 0.77 | 0.0135 | 0.0105 | 0.012 | 0.055 | 0.0085 | 0.009 | 0.0095 | 0.00315 |
| KP 12 | 0.016 | 0.0095 | 0.0075 | 0.0085 | 0.039 | 0.006 | 0.0065 | 0.007 | 0.0023 |
| KP 15 | | 0.018 | 0.014 | 0.016 | 0.075 | 0.0115 | 0.0125 | 0.013 | 0.0043 |
| KP 16 | 0.18 | 0.014 | 0.011 | 0.0125 | 0.055 | 0.009 | 0.0095 | 0.01 | 0.00335 |
| KP 17 | | 0.041 | 0.0315 | 0.036 | 0.165 | 0.026 | 0.028 | 0.0295 | 0.0095 |
| KP 21 | 1.0 | 0.0095 | 0.0075 | 0.0085 | 0.0395 | 0.006 | 0.0065 | 0.007 | 0.0023 |
| KP 22 | 0.0165 | 0.0095 | 0.0075 | 0.0085 | 0.0395 | 0.006 | 0.0065 | 0.007 | 0.0023 |
| KP 23 | 0.016 | 0.0095 | 0.0075 | 0.0085 | 0.0385 | 0.006 | 0.0065 | 0.007 | 0.00225 |
| KP 25 | 0.016 | 0.0095 | 0.0075 | 0.0085 | 0.039 | 0.006 | 0.0065 | 0.007 | 0.0023 |
| KP 26 | 0.49 | 0.022 | 0.017 | 0.0195 | 0.09 | 0.014 | 0.015 | 0.016 | 0.0055 |
| KP 27 | 0.41 | 0.0105 | 0.008 | 0.009 | 0.0415 | 0.0065 | 0.007 | 0.0075 | 0.00245 |
| KP 31 | 0.016 | 0.0095 | 0.0075 | 0.0085 | 0.039 | 0.006 | 0.0065 | 0.007 | 0.00225 |

Appendix B. SOC concentrations (ng/g lipid) in fish. Concentrations below the detection limit are represented by half of the estimated detection limits shown in blue. Blank cells represent SOC concentrations in laboratory blanks that were at least 30% the concentration in the sample.

| Sample Name | TFLN ng/g lipid | HCB ng/g lipid | a-HCH ng/g lipid | g-HCH ng/g lipid | DCPA ng/g lipid | CLPYR ng/g lipid | HCLR E ng/g lipid | o-CLDN ng/g lipid | t-CLDN ng/g lipid | c-CLDN ng/g lipid |
|---|---|---|---|---|---|---|---|---|---|---|
| BL 1 | | 6.1 | 0.245 | 0.345 | 6.2 | 0.18 | 0.9 | 0.7 | 0.0205 | 1.6 |
| BL 2 | | 7.1 | 0.25 | 0.35 | 5.0 | 0.185 | 0.95 | 0.7 | 0.021 | 1.65 |
| BL 6 | | 13 | 1.25 | 1.75 | 20 | 0.9 | 4.8 | 3.5 | 0.105 | 8.5 |
| BL 8 | | 5 | 0.145 | 0.205 | 4.7 | 0.105 | 0.55 | 1.7 | 0.0125 | 0.95 |
| BL 9 | | 5.3 | 0.105 | 0.145 | 5.4 | 0.075 | 0.395 | 1.7 | 1.2 | 0.7 |
| BL 10 | | 28 | 0.13 | 0.185 | 9.2 | 0.75 | 2.4 | 8.0 | 14 | 20.0 |
| BL 11 | | 6.4 | 0.245 | 0.345 | 6.8 | 0.18 | 0.9 | 0.7 | 0.0205 | 1.6 |
| BL 13 | | 5.2 | 0.13 | 0.185 | 4.7 | 0.095 | 0.495 | 2.5 | 1.6 | 0.85 |
| BL 14 | | 6.4 | 0.09 | 0.12 | 5.2 | 0.065 | 0.33 | 2.4 | 1.7 | 0.55 |
| BL 16 | | 6.3 | 0.155 | 0.215 | 5.6 | 0.11 | 0.6 | 0.425 | 0.013 | 1 |
| BL 19 | | 11.00 | 0.75 | 1.05 | 15 | 0.55 | 2.85 | 2.05 | 0.065 | 4.9 |
| BL 21 | | 6.4 | 0.12 | 0.165 | 5.1 | | 0.445 | 2.3 | 1.4 | 0.75 |
| BL 23 | | 6.3 | 0.07 | 0.095 | 6.9 | 0.05 | 0.26 | 3.3 | 1.5 | 0.45 |
| BL 24 | | 5.5 | 0.115 | 0.16 | 5.8 | 0.085 | 0.435 | 0.32 | 1.3 | 0.75 |
| BL 26 | | 5 | 0.085 | 0.115 | 4.8 | 0.06 | 0.315 | 1.6 | 1.2 | 0.55 |
| BL 28 | | 5.5 | 0.205 | 0.285 | 5.4 | 0.15 | 0.75 | 0.55 | 0.017 | 1.35 |
| BL 29 | | 3.8 | 0.23 | 0.32 | 4.7 | 0.165 | 0.85 | 0.65 | 0.0195 | 1.5 |
| KP 3 | | 6.4 | 0.016 | 0.0225 | 2.8 | 0.11 | 0.75 | 2.7 | 4.3 | 0.105 |
| KP 5 | | 5.3 | 0.075 | 0.105 | 2.8 | 0.055 | 0.275 | 0.205 | 3.1 | 0.48 |
| KP 6 | | 6.1 | 0.0305 | 0.0425 | 2.9 | 0.022 | 0.115 | 2.5 | 4.6 | 0.2 |
| KP 7 | | 7.7 | 0.034 | 0.0475 | 2.8 | 0.0245 | 0.13 | 3.8 | 5.3 | 0.22 |
| KP 8 | | 6 | 0.02 | 0.028 | 5.3 | 0.0145 | 1.0 | 2.5 | 3.4 | 0.13 |
| KP 9 | | 5.8 | 0.0265 | 0.037 | 3.3 | 0.14 | 1.1 | 2.9 | 4.6 | 0.17 |
| KP 11 | | 6.80 | 0.0315 | 0.0445 | 3.2 | 0.023 | 0.12 | 4.1 | 5.1 | 0.205 |
| KP 12 | | 5.8 | 0.022 | 0.0305 | 3.5 | 0.016 | 0.68 | 2.5 | 4.6 | 0.14 |
| KP 15 | | 5.4 | 0.0315 | 0.0445 | 2.9 | 0.023 | 0.12 | 2.4 | 3.0 | 0.205 |
| KP 16 | | 6.4 | 0.0305 | 0.0425 | 2.3 | 0.16 | 0.93 | 3.1 | 5.0 | 0.2 |
| KP 17 | | 5.5 | 0.085 | 0.115 | 2.4 | 0.06 | 0.315 | 0.23 | 2.6 | 0.55 |
| KP 21 | 0.55 | 9.6 | 0.055 | 0.08 | 4.1 | 1.4 | 0.215 | 3.3 | 10 | 0.375 |
| KP 22 | 0.14 | 6.7 | 0.017 | 0.0235 | 1.4 | 0.0125 | 0.065 | 2.4 | 3.5 | 0.11 |
| KP 23 | | 6.3 | 0.017 | 0.0235 | 1.2 | 0.0125 | 0.065 | 1.6 | 3.2 | 3.7 |
| KP 25 | 0.43 | 6.4 | 0.0285 | 0.0395 | 3.3 | 0.3 | 1.3 | 4.5 | 6.3 | 0.185 |
| KP 26 | | 6.2 | 0.055 | 0.075 | 2.8 | 0.35 | 0.205 | 2.9 | 3.7 | 0.36 |
| KP 27 | | 5.6 | 0.016 | 0.0225 | 2.8 | 0.0115 | 0.06 | 2.6 | 2.9 | 0.105 |
| KP 31 | | 7.9 | 0.027 | 0.038 | 3.8 | 0.0195 | 0.87 | 3.6 | 6.9 | 0.175 |

| Sample Name | t-NCLR ng/g lipid | c-NCLR ng/g lipid | Dieldrin ng/g lipid | ENDO I ng/g lipid | ENDO II ng/g lipid | ENDO S ng/g lipid | Mirex ng/g lipid | op-DDE ng/g lipid | pp-DDE ng/g lipid | op-DDD ng/g lipid | pp-DDD ng/g lipid | pp-DDT ng/g lipid | MXCLR ng/g lipid | CHR/TRI ng/g lipid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BL 1 | 7.4 | 4.3 | 1.85 | 0.155 | 0.235 | 6.6 | 0.24 | 4.25 | 48 | 5 | 11.5 | 9 | | 1.45 |
| BL 2 | 18 | 8.9 | 1.9 | 0.16 | 0.24 | 6.4 | 0.245 | 4.4 | 350 | 5 | 11.5 | 9.5 | | 1.5 |
| BL 6 | 19 | 8.2 | 9.5 | 14.0 | 1.2 | 11 | 1.25 | 22 | 97 | 26 | 60 | 47 | | 7.5 |
| BL 8 | 6.1 | 5.9 | 2.8 | 1.3 | 0.14 | 8.5 | 0.145 | 2.55 | 94 | 3 | 7 | 5.5 | | 0.85 |
| BL 9 | 6.1 | 3.4 | 3.2 | 0.99 | 0.1 | 4.7 | 0.105 | 1.85 | 38 | 2.15 | 4.85 | 3.9 | | 0.6 |
| BL 10 | 38 | 28 | 29 | 14.0 | 3.0 | 42 | 0.13 | 2.3 | 570 | 2.7 | 6 | 4.9 | | 0.75 |
| BL 11 | 8.7 | 3.9 | 1.85 | 4.8 | 0.235 | 6.0 | 0.24 | 4.25 | 49 | 5 | 11.5 | 9 | | 1.45 |
| BL 13 | 11 | 6.1 | 2.7 | 1.8 | 0.125 | 6.7 | 0.13 | 2.3 | 200 | 2.7 | 6 | 4.9 | | 0.75 |
| BL 14 | 7.2 | 4.4 | 3.0 | 2.5 | 0.085 | 6.9 | 0.085 | 1.5 | 63 | 1.8 | 4.05 | 3.25 | | 0.5 |
| BL 16 | 8.0 | 5.2 | 3.3 | 1.6 | 0.145 | 3.3 | 0.15 | 2.65 | 76 | 3.15 | 7 | 5.5 | | 0.9 |
| BL 19 | 13 | 5.5 | 5.5 | 8.3 | 0.7 | 11 | 0.75 | 13 | 70 | 15.5 | 35 | 28 | | 4.4 |
| BL 21 | 9.1 | 6.4 | 2.4 | 1.3 | 0.115 | 7.2 | 0.115 | 2.05 | 86 | 2.45 | 5.5 | 4.4 | | 0.7 |
| BL 23 | 11 | 4.1 | 9.4 | 1.8 | 0.065 | 5.4 | 0.07 | 1.2 | 53 | 1.4 | 3.2 | 2.6 | | 0.405 |
| BL 24 | 7.1 | 3.7 | 2.1 | 1.4 | 0.11 | 0.58 | 0.11 | 2 | 56 | 2.35 | 5.5 | 4.25 | | 0.65 |
| BL 26 | 6.6 | 4.5 | 2.4 | 1.6 | 0.08 | 3.5 | 0.08 | 1.45 | 38 | 1.7 | 3.9 | 3.1 | | 0.49 |
| BL 28 | 4.1 | 2.9 | 1.5 | 1.4 | 0.195 | 6.4 | 0.2 | 3.55 | 34 | 4.2 | 9.5 | 7.5 | | 1.2 |
| BL 29 | 4.9 | 2.1 | 1.7 | 2.0 | 0.22 | 5.3 | 0.225 | 4 | 19 | 4.7 | 10.5 | 8.5 | | 1.35 |
| KP 3 | 9.5 | 5.0 | 7.8 | 5.1 | 0.85 | 6.5 | 0.016 | 0.28 | 160 | 0.33 | 0.75 | 0.6 | 4.9 | 0.095 |
| KP 5 | 7.3 | 3.5 | 13 | 6.0 | 0.68 | 8.7 | 0.07 | 1.3 | 54 | 1.5 | 3.4 | 2.75 | | 0.43 |
| KP 6 | 10 | 5.7 | 9.4 | 1.8 | 0.95 | 5.3 | 0.0295 | 0.55 | 83 | 0.6 | 1.4 | 1.15 | 13 | 0.18 |
| KP 7 | 16 | 7.0 | 9.5 | 2.3 | 0.67 | 6.0 | 0.0335 | 0.6 | 190 | 0.7 | 1.6 | 1.25 | | 0.2 |
| KP 8 | 12 | 5.8 | 13 | 1.1 | 0.61 | 4.2 | 0.0195 | 0.35 | 0.6 | 0.41 | 0.95 | 0.75 | | 0.12 |
| KP 9 | 15 | 6.5 | 12 | 1.4 | 0.43 | 5.8 | 0.026 | 0.46 | 120 | 0.55 | 1.25 | 1 | 8.9 | 0.155 |
| KP 11 | 17 | 7.7 | 11 | 5.4 | 0.61 | 10 | 0.031 | 0.55 | 170 | 0.65 | 1.45 | 1.15 | | 0.185 |
| KP 12 | 16 | 8.9 | 11 | 1.7 | 0.61 | 2.6 | 0.0215 | 0.38 | 400 | 0.445 | 1 | 0.8 | 4.9 | 0.13 |
| KP 15 | 6.7 | 3.2 | 11 | 5.4 | 0.79 | 6.9 | 0.031 | 0.55 | 75 | 0.65 | 1.45 | 1.2 | | 0.185 |
| KP 16 | 13 | 6.5 | 9.4 | 5.2 | 0.65 | 8.7 | 0.0295 | 0.55 | 140 | 0.6 | 1.4 | 1.15 | | 0.18 |
| KP 17 | 5.7 | 2.8 | 12 | 2.0 | 0.54 | 6.6 | 0.08 | 1.45 | 51 | 1.7 | 3.9 | 3.1 | | 0.49 |
| KP 21 | 42 | 60 | 15 | 2.3 | 2.8 | 25 | 3.7 | 1 | 400 | 1.15 | 2.65 | 2.15 | | 0.335 |
| KP 22 | 7.6 | 5.9 | 8.2 | 5.2 | 0.75 | 1.6 | 0.0165 | 0.295 | 0.5 | 0.345 | 0.8 | 0.65 | 6.6 | 0.1 |
| KP 23 | 21 | 12 | 6.7 | 3.8 | 0.41 | 7.6 | 1.1 | 0.295 | 0.5 | 0.345 | 0.8 | 0.65 | | 0.1 |
| KP 25 | 23 | 10 | 17 | 5.6 | 0.77 | 4.2 | 0.72 | 0.49 | 180 | 0.6 | 1.3 | 1.05 | | 0.165 |
| KP 26 | 8.5 | 4.1 | 12 | 6.1 | 0.76 | 8.7 | 0.055 | 0.95 | 67 | 1.1 | 2.55 | 2.05 | | 0.32 |
| KP 27 | 6.6 | 2.9 | 7.5 | 4.7 | 0.73 | 4.6 | 0.0155 | 0.28 | 50 | 0.325 | 0.75 | 0.6 | 4 | 0.095 |
| KP 31 | 23 | 12 | 14 | 5.6 | 0.67 | 6.6 | 0.75 | 0.47 | 0.8 | 0.55 | 1.25 | 1 | 7.2 | 0.16 |

| Sample Name | PCB 101 ng/g lipid | PCB 118 ng/g lipid | PCB 138 ng/g lipid | PCB 153 ng/g lipid | PCB 183 ng/g lipid | PCB 187 ng/g lipid | FLO ng/g lipid | PHE ng/g lipid | ANT ng/g lipid | FLA ng/g lipid | PYR ng/g lipid |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BL 1 | 3.35 | 0.26 | 2.3 | 2.6 | 0.30 | 1.1 | | | 4.35 | | |
| BL 2 | 3.45 | 6.2 | 20 | 23 | 2.8 | 9.8 | 1.2 | | 4.45 | 0.55 | |
| BL 6 | 17.5 | 1.35 | 0.8 | 6.2 | 0.12 | 0.135 | | | 22.5 | | |
| BL 8 | 2 | 1.5 | 4.5 | 4.7 | 0.65 | 2.2 | | | 2.6 | | |
| BL 9 | 1.45 | 1.3 | 2.6 | 3.2 | 0.36 | 1.3 | | | 1.85 | | |
| BL 10 | 1.8 | 8.5 | 14 | 18 | 2.3 | 8.1 | 0.65 | | 2.3 | 8.2 | |
| BL 11 | 3.35 | 0.26 | 3.5 | 3.3 | 0.46 | 1.5 | | | 4.35 | | |
| BL 13 | 1.8 | 2.4 | 6.3 | 7.1 | 0.86 | 3.1 | 0.65 | | 2.3 | | |
| BL 14 | 1.2 | 1.5 | 3.9 | 4.2 | 0.50 | 1.9 | 0.42 | 130 | 1.55 | 0.2 | |
| BL 16 | 2.1 | 1.5 | 4.4 | 4.5 | 0.59 | 2.1 | | | 2.7 | | |
| BL 19 | 10 | 0.8 | 5.6 | 5.4 | 0.86 | 2.2 | | 680.00 | 13.5 | | |
| BL 21 | 1.6 | 1.9 | 5.2 | 5.5 | 0.61 | 2.4 | 0.55 | | 2.1 | | -0.48 |
| BL 23 | 0.95 | 1.7 | 3.6 | 3.9 | 0.51 | 1.8 | 96 | 28 | 1.25 | 0.155 | -0.28 |
| BL 24 | 1.55 | 1.5 | 4.2 | 4.5 | 0.53 | 2.0 | | | 2.05 | | |
| BL 26 | 1.15 | 0.95 | 2.8 | 2.8 | 0.37 | 1.2 | | | 1.5 | | |
| BL 28 | 2.8 | 0.215 | 2.3 | 2.4 | 0.28 | 0.73 | 1 | | 3.6 | | |
| BL 29 | 3.15 | 0.245 | 0.145 | 1.3 | 0.0215 | 0.43 | 1.1 | | 4.05 | | |
| KP 3 | 0.22 | 1.9 | 3.0 | 3.5 | 0.51 | 1.6 | | | 0.285 | 1.9 | 1.4 |
| KP 5 | 1 | 0.98 | 1.5 | 2.0 | 0.32 | 0.92 | 0.35 | | 1.3 | 3.8 | 3.6 |
| KP 6 | 0.415 | 1.9 | 2.4 | 3.2 | 0.44 | 1.5 | 0.145 | | 0.55 | 0.07 | |
| KP 7 | 0.465 | 3.4 | 4.8 | 6.0 | 0.85 | 2.7 | 0.165 | | 0.6 | 0.075 | |
| KP 8 | 0.275 | 1.9 | 3.0 | 3.3 | 0.44 | 1.7 | 0.095 | 12 | 0.355 | | |
| KP 9 | 0.36 | 2.4 | 3.7 | 4.4 | 0.65 | 2.1 | 0.125 | | 0.47 | 1.6 | |
| KP 11 | 0.43 | 3.2 | 5.2 | 6.4 | 0.94 | 3.0 | | | 0.55 | | |
| KP 12 | 0.295 | 1.5 | 2.7 | 3.4 | 0.48 | 1.9 | 0.105 | 9.8 | 0.385 | | |
| KP 15 | 0.43 | 1.0 | 1.8 | 1.8 | 0.25 | 0.86 | 0.15 | | 0.55 | | |
| KP 16 | 0.415 | 1.9 | 2.8 | 3.7 | 0.50 | 1.7 | 0.145 | | 0.55 | 1.9 | 1.2 |
| KP 17 | 1.15 | 0.93 | 1.8 | 1.9 | 0.27 | 0.86 | 0.4 | | 1.5 | | |
| KP 21 | 0.8 | 6.8 | 12 | 15 | 1.9 | 8.4 | | | 1 | 0.13 | |
| KP 22 | 0.23 | 0.018 | 2.6 | 2.7 | 0.39 | 1.5 | | | 0.3 | | |
| KP 23 | 1.9 | 0.44 | 4.7 | 5.4 | 0.58 | 3.3 | | 12 | 0.3 | 0.0385 | |
| KP 25 | 0.385 | 2.1 | 4.5 | 6.2 | 1.1 | 3.0 | 12 | | 0.5 | 2.4 | 1.7 |
| KP 26 | 0.75 | 1.5 | 2.5 | 2.8 | 0.39 | 1.3 | 0.26 | | 0.95 | | |
| KP 27 | 0.22 | 1.1 | 1.8 | 2.0 | 0.30 | 0.94 | | | 0.285 | 1.2 | 1.1 |
| KP 31 | 0.37 | 3.0 | 5.1 | 5.9 | 0.80 | 3.2 | 15 | 23 | 0.48 | 3.7 | 2.3 |

| Sample Name | Retene ng/g lipid | B[a]A ng/g lipid | B[b]F ng/g lipid | B[k]F ng/g lipid | B[e]P ng/g lipid | B[a]P ng/g lipid | I[1,2,3-cd]p ng/g lipid | D[ah]A ng/g lipid | B[ghi]P ng/g lipid |
|---|---|---|---|---|---|---|---|---|---|
| BL 1 | 3.25 | 1.95 | 1.5 | 1.7 | 8 | 1.25 | 1.3 | 1.4 | 0.46 |
| BL 2 | 3.35 | 2 | 1.55 | 1.75 | 8 | 1.25 | 1.35 | 1.45 | 0.475 |
| BL 6 | 17 | 10 | 8 | 9 | 40.5 | 6.5 | 7 | 7 | 2.4 |
| BL 8 | 1.95 | 1.15 | 0.9 | 1.05 | 4.7 | 0.75 | 0.8 | 0.85 | 0.275 |
| BL 9 | 1.4 | 0.85 | 0.65 | 0.75 | 3.35 | 0.55 | 0.55 | 0.6 | 0.195 |
| BL 10 | 16 | 1.05 | 0.8 | 0.9 | 4.2 | 0.65 | 0.7 | 0.75 | 0.245 |
| BL 11 | 3.25 | 1.95 | 1.5 | 1.7 | 8 | 1.25 | 1.3 | 1.4 | 0.46 |
| BL 13 | | 1.05 | 0.8 | 0.9 | 4.2 | 0.65 | 0.7 | 0.75 | 0.245 |
| BL 14 | 1.15 | 0.7 | 0.55 | 0.6 | 2.8 | 0.44 | 0.47 | 0.495 | 0.165 |
| BL 16 | 2.05 | 1.2 | 0.95 | 1.05 | 4.9 | 0.75 | 0.85 | 0.85 | 0.29 |
| BL 19 | 10 | 6 | 4.6 | 5 | 24 | 3.75 | 4.05 | 4.25 | 1.4 |
| BL 21 | 1.55 | 0.95 | 0.75 | 0.85 | 3.8 | 0.6 | 0.65 | 0.65 | 0.225 |
| BL 23 | 0.9 | 0.55 | 0.425 | 0.485 | 11 | 0.345 | 0.375 | 0.395 | 0.13 |
| BL 24 | 1.5 | 0.9 | 0.7 | 0.8 | 3.7 | 0.6 | 0.6 | 0.65 | 0.215 |
| BL 26 | 1.1 | 0.65 | 0.5 | 0.6 | 2.7 | 0.42 | 0.45 | 0.475 | 0.155 |
| BL 28 | 2.7 | 1.6 | 1.25 | 1.45 | 6.5 | 1 | 1.1 | 1.15 | 0.385 |
| BL 29 | | 1.8 | 1.4 | 1.6 | 7.5 | 1.15 | 1.25 | 1.3 | 0.43 |
| KP 3 | 0.215 | 0.125 | 0.1 | 0.115 | 0.5 | 0.08 | 0.085 | 0.09 | 0.0305 |
| KP 5 | 17 | 0.6 | 0.45 | 0.5 | 2.35 | 0.37 | 0.395 | 0.415 | 0.14 |
| KP 6 | 6.3 | 0.24 | 0.185 | 0.215 | 0.95 | 0.15 | 0.165 | 0.17 | 0.055 |
| KP 7 | 0.45 | 0.27 | 0.21 | 0.24 | 1.1 | 0.17 | 0.185 | 0.195 | 0.065 |
| KP 8 | 0.265 | 0.16 | 0.125 | 0.14 | 0.65 | 0.1 | 0.11 | 0.115 | 0.0375 |
| KP 9 | 10 | 0.21 | 0.16 | 0.185 | 0.85 | 0.13 | 0.145 | 0.15 | 0.0495 |
| KP 11 | 14 | 0.25 | 0.195 | 0.22 | 1 | 0.16 | 0.17 | 0.18 | 0.06 |
| KP 12 | 0.29 | 0.17 | 0.135 | 0.15 | 0.7 | 0.11 | 0.115 | 0.125 | 0.041 |
| KP 15 | | 0.25 | 0.195 | 0.22 | 1 | 0.16 | 0.17 | 0.18 | 0.06 |
| KP 16 | 3 | 0.24 | 0.185 | 0.215 | 0.95 | 0.15 | 0.165 | 0.17 | 0.055 |
| KP 17 | | 0.65 | 0.5 | 0.6 | 2.7 | 0.42 | 0.45 | 0.475 | 0.155 |
| KP 21 | 47 | 0.455 | 0.35 | 0.4 | 1.85 | 0.29 | 0.31 | 0.325 | 0.11 |
| KP 22 | 0.225 | 0.135 | 0.105 | 0.12 | 0.55 | 0.085 | 0.09 | 0.095 | 0.032 |
| KP 23 | 0.225 | 0.135 | 0.105 | 0.12 | 0.55 | 0.085 | 0.09 | 0.095 | 0.032 |
| KP 25 | 0.375 | 0.225 | 0.175 | 0.2 | 0.9 | 0.14 | 0.155 | 0.16 | 0.055 |
| KP 26 | 9.6 | 0.435 | 0.335 | 0.385 | 1.75 | 0.275 | 0.295 | 0.31 | 0.105 |
| KP 27 | 5 | 0.125 | 0.1 | 0.11 | 0.5 | 0.08 | 0.085 | 0.09 | 0.03 |
| KP 31 | 0.36 | 0.215 | 0.165 | 0.19 | 0.85 | 0.135 | 0.145 | 0.155 | 0.05 |