Supporting On-line Material: Methods

The farmed Atlantic salmon (*Salmo salar*) were purchased from wholesale suppliers in the United States, the United Kingdom, Norway, and Canada and directly from retail outlets in 16 cities in Europe and North America. All such samples were purchased in the period from March through December 2002. Wholesale salmon were selected to include salmon farmed in British Columbia, Chile, Eastern Canada, the Faroe Islands, Maine, Norway, Scotland, and Washington state. The farms reflect those farms from which suppliers could obtain Atlantic salmon of the appropriate size within the sampling period. The number of farms sampled per region and the corresponding total production per region in 2000 are presented in Table Sl. One to three wholesale suppliers provided fish from each of these eight regions for a total of 51 farms. Suppliers provided information on the origin of the fish (region and farm) by including the original labels from the farm source where possible or by filling in labels we provided to them for this purpose. When necessary for clarification, we confirmed the written information verbally or by e-mail with the suppliers. Ten fish were obtained from each farm, nine of which were randomly grouped into three composites of three fish each. Most individual fish weighed ~4-6 kg. A total of 459 farmed salmon from wholesalers was used to produce 153 samples for analysis. Viscera and gills were removed from the fish before shipment, but the heads were left on. Three whole fillet samples were obtained from each of three retail outlets in 16 cities (Boston, Chicago, Denver, Edinburgh, Frankfurt, London, Los Angeles, New Orleans, New York, Oslo, Paris, San Francisco, Seattle, Toronto, Vancouver, and Washington DC); composites were made of these 144 fillets by retail outlet to give three samples for each city, for a total of 48 samples for analysis.

Between September 2001 and August 2002, other suppliers provided 135 wild fish representing five wild species of Pacific salmon: chum *(Oncorhyncus keta)*, coho *(O. kisutch)*, chinook *(O. tshawytscha)*, pink *(O. gorbuscha)*, and sockeye *(O. nerka)*. Samples of each species were purchased from suppliers located in different geographic regions, who purchase locally-caught fish, including Kodiak, Alaska; Southeast Alaska; British Columbia, and Oregon. Three composites of three fish for each species at each of three different locations resulted in a total of 45 samples for analysis.

All samples came to the analytical laboratory (AXYS Analytical in Sidney, British Columbia) fresh or frozen on ice or gel-packs. Fish were thawed and inspected by a fisheries biologist to verify species. Each fish was weighed, its length measured, and filleted to give two skin-on fillets. We analyzed skin-on fillets because most salmon are sold at retail outlets with the skin on. In each case, the fillets from three fish were ground and re-ground together to make a homogenous composite.

We used U.S. EPA methods to measure the concentrations of dioxins and PCBs. Other organochlorine pesticides were measured using analogous procedures. All methods were based on gas chromatographic high resolution mass spectrometry (GC/HRMS) with isotopically labeled internal standards. Chlorinated dibenzo-*p*-dioxins and dibenzofurans were measured using EPA Method 1613, which was calibrated with an extra standard that was one-fifth the concentration of the method requirement. The dioxin concentrations were reported as toxic equivalents (TEQs) assuming non-detects were zero (to be conservative) and using WHO toxic equivalent factors. PCBs were quantitated using EPA Method 1668A; this technique is an isotope-dilution, congener-specific method for the twelve dioxin-like congeners and an internal standard method for the remaining 197 congeners. The dioxin-like

PCB concentrations were reported as TEQs assuming non-detects were zero (to be conservative) and using WHO toxic equivalent factors. Total dioxin TEQs were the sum of the TEQs from dioxins plus those from dioxin-like PCBs. The organochlorine pesticides were measured using a GC/HRMS isotope dilution method analogous to the EPA methods used for dioxin and PCB analyses. Toxaphene was measured by gas chromatographic mass spectrometry operated in the electron capture negative ion mode. Quantification of total toxaphene was achieved using ^{13}C-labeled PCB-180 as the internal standard and Hercules toxaphene as the reference. Quantification of dieldrin was achieved using ^{13}C-labeled dieldrin as the internal standard.

Fish feed samples were purchased from European and North and South American outlets of the two major fish feed companies. For the first company, two samples of feed, purchased three to four months apart, were obtained from facilities in Scotland, Eastern Canada, British Columbia, and Chile. For the second company, two samples of feed, purchased three to four months apart, were obtained from facilities in Scotland and British Columbia, and one sample from a facility in Chile. Where possible, two samples per location were purchased several months apart in order to account for possible seasonal variations in the fish feed formulation.

All analyses were conducted in accordance with AXYS's accredited QA/QC program. Each analysis batch of nine samples also included a procedural blank, a "known" or laboratory control sample, and an analysis duplicate. The sample results were reviewed and evaluated in relation to the QA/QC samples worked up at the same time. The sample internal standard recoveries and detection limits, procedural blank data, and laboratory control sample data were evaluated against method criteria to ensure data quality. All instrument QA specifications for EPA Methods were adhered to and applied to all analyses conducted for this

study. All data met the QA/QC specifications. In general, duplicate measurements differed from each other by < 15%. Reported concentrations were adjusted for the recoveries of the internal standards. All blank measurements were near or below the detection limits (typically <0.02 pg/g for dioxins/furans, <0.2 pg/g for dioxin-like PCBs, 0.001 ng/g for dieldrin, and 0.1 ng/g for toxaphene); hence, blank values were not subtracted from the sample measurements. Certified reference samples (NIST SRMs or Radian CRMs) were analyzed periodically to demonstrate analytical accuracy.

Risk-based consumption advice for PCBs, toxaphene, and dieldrin was generated using contaminant concentrations found in farmed and wild salmon, the U.S. EPA Cancer Slope Factors for each compound, and an acceptable risk level of 1×10^{-5} (*S1*). For all risk estimates and consumption calculations, it was assumed that an average meal size was 227 g (0.5 pounds) and the body weight of an average individual was 70 kg.

The statistical analyses are based on the analysis of variance, using the model

$$y_{ijk} = \mu + \tau_i + e_{ij} + d_{ijk}$$

where

y_{ijk} = the observed value of a response variable (one of the 14 contaminants)

μ = the overall (grand mean) value

τ_i = the effect of kind i – depending on the specific analysis, this could represent wild, farmed, farmed in North America, or other such groups

e_{ij} = the effect of source j of kind i – depending on the specific analysis, this could represent a batch of salmon from a particular location, from which a set of 3 composites was formed

d_{ijk} = the effect of composite (observation) *k* of source *j* of kind *i*, where *k* = 1, 2, 3 for each source, because there were always 3 replicate composites per source

To make inferences about the terms τ_i, the effects of different kinds of salmon, relative to one another, the appropriate measure of variability is source-to-source variation, not variation among composites. The statistical tests for differences between kinds of salmon are *F*-tests, with degrees of freedom based on the number of sources present in the analysis (not the number of composites). For example, in an analysis of differences among the three farming continents, there are 153 observations, which represent 51 sources, so the statistical *F*-tests involve 2 (= 3 – 1) degrees of freedom in the numerator for differences in means among the three regions and 48 (= 51 – 3) degrees of freedom in the denominator for differences among sources. (For a general exposition of *F*-tests, *p*-values, and the model used here, see, for example, Sections 2.10, 2.11, and 5.9 of *Statistical Principles of Research Design and Analysis*, 2nd edition, Robert O. Kuehl, 2000, Duxbury Press.)

Reference

S1. United States Environmental Protection Agency, *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2. Risk Assessment and Fish Consumption Limits*, 3rd edition. U.S. EPA, Washington, D.C. (2000). Available at: http://www.epa.gov/ost/fishadvice/volume2/index.html

Table S1. Farmed Atlantic salmon production levels in 2000, by weight for each of the major salmon-producing regions in the world, and the number of farms from which fish were obtained for this study. Weight is rounded to the nearest 100 mt.

Region	Number of farms sampled	Production in region in 2000 (mt)	Sources
Norway	4	437,000	Food and Agriculture Organization/Fisheries Global Information Systems (www.fao.org)
Chile	10	167,000	Food and Agriculture Organization/Fisheries Global Information Systems (www.fao.org)
Scotland (UK)	10	130,000	Food and Agriculture Organization/Fisheries Global Information Systems (www.fao.org)
British Columbia	6	39,100	Government of British Columbia, Ministry of Agriculture, Food and Fisheries, Fisheries Statistics (www.agf.gov.bc.ca/fish_stats/aqua-salmon-2000.htm)
Eastern Canada	8	29,100	Government of Nova Scotia, Agriculture and Fisheries Statistics (www.gov.ns.ca/nsaf/aquaculture/stats/2000.htm); Government of New Brunswick, Fisheries, Aquaculture and Agriculture 2000-2001 Annual Report (Available through www.gnb.ca); Government of Newfoundland and Labrador, Fisheries and Aquaculture Statistics (www.gov.nf.ca/Fishaq/Statistics/aqua2000.stm)
Faroe Islands	8	28,300	Food and Agriculture Organization/Fisheries Global Information Systems (www.fao.org)
Ireland:	0	20,000	Commodity Update – Salmon, Globefish, Food and Agriculture Organization of the United Nations. 2002. Rome, Italy.
Maine, U.S.	2	16,400	Maine Department of Marine Resources, Lease inventory (www.state.me.us/dmr/aquaculture/lease_inventory/inventorylist.htm)
Washington, U.S.	3	6,100	Personal communication, Lee Hoines, Washington Department of Fish and Wildlife.
Iceland	0	2,600	Food and Agriculture Organization/Fisheries Global Information Systems (www.fao.org)