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National Guidance

Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories

Volume 2: Risk Assessment and Fish Consumption Limits - Third Edition

SECTION

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SECTION 4

RISK-BASED CONSUMPTION LIMIT TABLES

4.1 OVERVIEW AND SECTION ORGANIZATION

This section provides consumption limit tables for carcinogenic and chronic health endpoints for the general adult population for all of the target analytes listed in Table 1-1.

Variables used to calculate the consumption limits include fish meal size, consumer body weight, contaminant concentration in the fish tissue, the time-averaging period selected (monthly), the reference dose for noncarcinogenic health endpoints, and the cancer potency factor and the maximum acceptable risk level for carcinogenic health endpoints. Default values for the variables are presented in Section 3 and described in greater detail in Section 2.

Each consumption table lists, by chemical, the maximum number of fish meals per unit time (monthly) that may be safely eaten. Readers may use these tables by: determining the chemical contaminant concentration in fish surveyed in local fish sampling and analysis programs and reading the value for the maximum number of meals per month that may be safely eaten for each contaminant for noncancer and cancer endpoints. For those contaminants with monthly fish consumption limits calculated for both the noncancer and cancer endpoints, EPA recommends using the more conservative of the two values. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.

Some of the contaminant concentrations shown in the consumption limit tables are below current laboratory detection limits. Because of improvements in chemical analysis procedures and associated technologies, however, chemical detection limits regularly decrease. The fish tissue concentrations that are currently below the limit of detection are provided so that risk managers may use them once lower detection limits are achievable through improvements in analytical procedures. **Note:** The reader should be aware that detection limits presented here are derived from state-of-the-art state, regional, and national fish monitoring programs and may not be representative of detection limits achievable in all laboratories. Readers should consult with the analytical chemists in their state responsible for analyzing fish tissue samples to ensure that their detection limits are comparable to those presented. If the detection limits presented are lower than those achieved in the state's program, the reader should make

necessary adjustments to the tables. The detection limits presented here are to provide general guidance on detection limits typically achievable using current analytical procedures. The reader should review Section 6 of Volume 1 for further information on chemical analysis procedures and associated detection and quantitation limits for the target analytes.

4.2 CONSUMPTION LIMIT TABLES

Tables 4-1 through 4-25 are consumption limit tables for carcinogenic and chronic systemic health endpoints for each of the target analytes. Readers using the tables as a basis for fish consumption advisories should note that the values given in the tables are valid **only** for single contaminants in single-species diets. Sections 3.4 and 3.5 describe methods for calculating consumption limits for multiple contaminant situations and for multiple fish species diets.

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-1. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Arsenic (inorganic)

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations, (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.088	0 - 0.002
16	>0.088 - 0.18	>0.002 - 0.0039
12	>0.18 - 0.23	>0.0039 - 0.0052
8	>0.23 - 0.35	>0.0052 - 0.0078
4	>0.35 - 0.7	>0.0078 - 0.016
3	>0.7 - 0.94	>0.016 - 0.021
2	>0.94 - 1.4	>0.021 - 0.031
1	>1.4 - 2.8	>0.031 - 0.063
0.5	>2.8 - 5.6	>0.063 - 0.13
None (<0.5)	>5.6	>0.13

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 3×10^{-4} mg/kg-d, and a cancer slope factor (CSF) of $1.5 \text{ (mg/kg-d)}^{-1}$.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for arsenic is 5×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-2. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Cadmium

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.088
16	>0.088 - 0.18
12	>0.18 - 0.23
8	>0.23 - 0.35
4	>0.35 - 0.7
3	>0.7 - 0.94
2	>0.94 - 1.4
1	>1.4 - 2.8
0.5	>2.8 - 5.6
None (<0.5)	>5.6

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 1×10^{-3} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for cadmium is 5×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-3. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Methylmercury

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.029
16	>0.029 - 0.059
12	>0.059 - 0.078
8	>0.078 - 0.12
4	>0.12 - 0.23
3	>0.23 - 0.31
2	>0.31 - 0.47
1	>0.47 - 0.94
0.5	>0.94 - 1.9
None (<0.5)	>1.9

* The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an interim RfD of 1×10^{-4} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for methylmercury is 1×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-4. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Selenium

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 1.5
16	>1.5 - 2.9
12	>2.9 - 3.9
8	>3.9 - 5.9
4	>5.9 - 12
3	>12 - 16
2	>16 - 23
1	>23 - 47
0.5	>47 - 94
None (<0.5)	>94

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 5×10^{-3} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for selenium is 17×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-5. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Tributyltin

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.088
16	>0.088 - 0.18
12	>0.18 - 0.23
8	>0.23 - 0.35
4	>0.35 - 0.7
3	>0.7 - 0.94
2	>0.94 - 1.4
1	>1.4 - 2.8
0.5	>2.8 - 5.6
None (<0.5)	>5.6

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 3×10^{-4} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for tributyltin is 2×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-6. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Chlordane

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b	Cancer Health Endpoints ^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.15	0 - 0.0084
16	>0.15 - 0.29	>0.0084 - 0.017
12	>0.29 - 0.39	>0.017 - 0.022
8	>0.39 - 0.59	>0.022 - 0.034
4	>0.59 - 1.2	>0.034 - 0.067
3	>1.2 - 1.6	>0.067 - 0.089
2	>1.6 - 2.3	>0.089 - 0.13
1	>2.3 - 4.7	>0.13 - 0.27
0.5	>4.7 - 9.4	>0.27 - 0.54
None (<0.5)	>9.4	>0.54

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

- Consumption limits are based on an adult body weight of 70 kg, an RfD of 5×10^{-4} mg/kg-d, and a cancer slope factor (CSF) of $0.35 \text{ (mg/kg-d)}^{-1}$.
- None = No consumption recommended.
- In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
- The detection limit for chlordane is 1×10^{-3} mg/kg.
- Instructions for modifying the variables in this table are found in Section 3.3.
- Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-7. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - DDT

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.015	0 - 0.0086
16	>0.015 - 0.029	>0.0086 - 0.017
12	>0.029 - 0.039	>0.017 - 0.023
8	>0.039 - 0.059	>0.023 - 0.035
4	>0.059 - 0.12	>0.035 - 0.069
3	>0.12 - 0.16	>0.069 - 0.092
2	>0.16 - 0.23	>0.092 - 0.14
1	>0.23 - 0.47	>0.14 - 0.28
0.5	>0.47 - 0.94	>0.28 - 0.55
None (<0.5)	>0.94	>0.55

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 5×10^{-4} mg/kg-d, and a cancer slope factor (CSF) of $0.34 \text{ (mg/kg-d)}^{-1}$.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for DDT is 1×10^{-4} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-8. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Dicofof

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.088
16	>0.088 - 0.18
12	>0.18 - 0.23
8	>0.23 - 0.35
4	>0.35 - 0.7
3	>0.7 - 0.94
2	>0.94 - 1.4
1	>1.4 - 2.8
0.5	>2.8 - 5.6
None (<0.5)	>5.6

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 4×10^{-4} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for dicofof is 1×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-9. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Dieldrin

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentration (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.015	0 - 0.00018
16	>0.015 - 0.029	>0.00018 - 0.00037
12	>0.029 - 0.039	>0.00037 - 0.00049
8	>0.039 - 0.059	>0.00049 - 0.00073
4	>0.059 - 0.12	>0.00073 - 0.0015
3	>0.12 - 0.16	>0.0015 - 0.002
2	>0.16 - 0.23	>0.002 - 0.0029
1	>0.23 - 0.47	>0.0029 - 0.0059
0.5	>0.47 - 0.94	>0.0059 - 0.012
None (<0.5)	>0.94	>0.012

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 5×10^{-5} mg/kg-d, and a cancer slope factor (CSF) of 16 (mg/kg-d)⁻¹.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for dieldrin is 1×10^{-4} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-10. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Endosulfan

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 1.8
16	>1.8 - 3.5
12	>3.5 - 4.7
8	>4.7 - 7
4	>7 - 14
3	>14 - 19
2	>19 - 28
1	>28 - 56
0.5	>56 - 110
None (<0.5)	>110

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 6×10^{-3} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for endosulfan is 5×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-11. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Endrin

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.088
16	>0.088 - 0.18
12	>0.18 - 0.23
8	>0.23 - 0.35
4	>0.35 - 0.7
3	>0.7 - 0.94
2	>0.94 - 1.4
1	>1.4 - 2.8
0.5	>2.8 - 5.6
None (<0.5)	>5.6

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 3×10^{-4} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for endrin is 1×10^{-4} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-12. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Heptachlor Epoxide

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.0038	0 - 0.00032
16	>0.0038 - 0.0076	>0.00032 - 0.00064
12	>0.0076 - 0.01	>0.00064 - 0.00086
8	>0.01 - 0.015	>0.00086 - 0.0013
4	>0.015 - 0.031	>0.0013 - 0.0026
3	>0.031 - 0.041	>0.0026 - 0.0034
2	>0.041 - 0.061	>0.0034 - 0.0052
1	>0.061 - 0.12	>0.0052 - 0.01
0.5	>0.12 - 0.24	>0.01 - 0.021
None (<0.5)	>0.24	>0.021

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 1.3×10^{-5} mg/kg-d, and a cancer slope factor (CSF) of $9.1 \text{ (mg/kg-d)}^{-1}$.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for heptachlor epoxide is 1×10^{-4} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-13. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Hexachlorobenzene

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.23	0 - 0.0018
16	>0.23 - 0.47	>0.0018 - 0.0037
12	>0.47 - 0.63	>0.0037 - 0.0049
8	>0.63 - 0.94	>0.0049 - 0.0073
4	>0.94 - 1.9	>0.0073 - 0.015
3	>1.9 - 2.5	>0.015 - 0.02
2	>2.5 - 3.8	>0.02 - 0.029
1	>3.8 - 7.5	>0.029 - 0.059
0.5	>7.5 - 15	>0.059 - 0.12
None (<0.5)	>15	>0.12

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Note:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 8×10^{-4} mg/kg-d, and a cancer slope factor (CSF) of $1.6 \text{ (mg/kg-d)}^{-1}$.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for hexachlorobenzene is 1×10^{-4} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-14. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Lindane

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.088	0 - 0.0023
16	>0.088 - 0.18	>0.0023 - 0.0045
12	>0.18 - 0.23	>0.0045 - 0.006
8	>0.23 - 0.35	>0.006 - 0.009
4	>0.35 - 0.7	>0.009 - 0.018
3	>0.7 - 0.94	>0.018 - 0.024
2	>0.94 - 1.4	>0.024 - 0.036
1	>1.4 - 2.8	>0.036 - 0.072
0.5	>2.8 - 5.6	>0.072 - 0.14
None (<0.5)	>5.6	>0.14

^a The assumed meal size is 8 oz (0.227 kg). A range of chemical concentrations are presented that are conservative, e.g. the 12 meal per month levels represent the concentrations associated with 12 meals up to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 3×10^{-4} mg/kg-d, and a cancer slope factor (CSF) of 1.3 (mg/kg-d)⁻¹.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for lindane is 1×10^{-4} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-15. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Mirex

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.059
16	>0.059 - 0.12
12	>0.12 - 0.16
8	>0.16 - 0.23
4	>0.23 - 0.47
3	>0.47 - 0.63
2	>0.63 - 0.94
1	>0.94 - 1.9
0.5	>1.9 - 3.8
None (<0.5)	>3.8

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and RfD of 2×10^{-4} mg/kg-d
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for mirex is 1×10^{-4} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-16. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Toxaphene

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.073	0 - 0.0027
16	>0.073 - 0.15	>0.0027 - 0.0053
12	>0.15 - 0.2	>0.0053 - 0.0071
8	>0.2 - 0.29	>0.0071 - 0.011
4	>0.29 - 0.59	>0.011 - 0.021
3	>0.59 - 0.78	>0.021 - 0.028
2	>0.78 - 1.2	>0.028 - 0.043
1	>1.2 - 2.3	>0.043 - 0.085
0.5	>2.3 - 4.7	>0.085 - 0.17
None (<0.5)	>4.7	>0.17

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 2.5×10^{-4} mg/kg-d, and a cancer slope factor (CSF) of 1.1 (mg/kg-d)⁻¹.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for toxaphene is 3×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-17. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Chlorpyrifos

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.088
16	>0.088 - 0.18
12	>0.18 - 0.23
8	>0.23 - 0.35
4	>0.35 - 0.7
3	>0.7 - 0.94
2	>0.94 - 1.4
1	>1.4 - 2.8
0.5	>2.8 - 5.6
None (<0.5)	>5.6

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 3×10^{-4} mg/kg-d.*
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for chlorpyrifos is 2×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

* Because of the potential for adverse neurological development effects, EPA recommends the use of a Population Adjusted Dose (PAD) of 3×10^{-5} mg/kg-d for infants, children to age six, and women aged 13-50.

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-18. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Diazinon

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.21
16	>0.21 - 0.41
12	>0.41 - 0.55
8	>0.55 - 0.82
4	>0.82 - 1.6
3	>1.6 - 2.2
2	>2.2 - 3.3
1	>3.3 - 6.6
0.5	>6.6 - 13
None (<0.5)	>13

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 7×10^{-4} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for diazinon is 2×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-19. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Disulfoton

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.012
16	>0.012 - 0.023
12	>0.023 - 0.031
8	>0.031 - 0.047
4	>0.047 - 0.094
3	>0.094 - 0.13
2	>0.13 - 0.19
1	>0.19 - 0.38
0.5	>0.38 - 0.75
None (<0.5)	>0.75

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 4×10^{-5} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for disulfoton is 2×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-20. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Ethion

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.15
16	>0.15 - 0.29
12	>0.29 - 0.39
8	>0.39 - 0.59
4	>0.59 - 1.2
3	>1.2 - 1.6
2	>1.6 - 2.3
1	>2.3 - 4.7
0.5	>4.7 - 9.4
None (<0.5)	>9.4

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 5×10^{-4} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for ethion is 2×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-21. Monthly Fish Consumption Limits for Noncarcinogenic Health Endpoint - Terbufos

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.0059
16	>0.0059 - 0.012
12	>0.012 - 0.016
8	>0.016 - 0.023
4	>0.023 - 0.047
3	>0.047 - 0.063
2	>0.063 - 0.094
1	>0.094 - 0.19
0.5	>0.19 - 0.38
None (<0.5)	>0.38

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and an RfD of 2×10^{-5} mg/kg-d.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for terbufos is 2×10^{-3} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-22. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - Oxyfluorfen

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.88	0 - 0.04
16	>0.88 - 1.8	>0.04 - 0.08
12	>1.8 - 2.3	>0.08 - 0.11
8	>2.3 - 3.5	>0.11 - 0.16
4	>3.5 - 7	>0.16 - 0.32
3	>7 - 9.4	>0.32 - 0.43
2	>9.4 - 14	>0.43 - 0.64
1	>14 - 28	>0.64 - 1.3
0.5	>28 - 56	>1.3 - 2.6
None (<0.5)	>56	>2.6

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Noted:

1. Consumption limits are based on an adult body weight of 70 kg, an RfD of 3×10^{-3} mg/kg-d, and a cancer slope factor (CSF) of 0.0732 (mg/kg-d)⁻¹.
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for oxyfluorfen is 1×10^{-2} mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-23. Monthly Fish Consumption Limits for Carcinogenic Health Endpoint - PAHs

Risk Based Consumption Limit^a	Noncancer Health Endpoints^b	Cancer Health Endpoints^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	NA	0 - 0.0004
16	NA	>0.0004 - 0.0008
12	NA	>0.0008 - 0.0011
8	NA	>0.0011 - 0.0016
4	NA	>0.0016 - 0.0032
3	NA	>0.0032 - 0.0043
2	NA	>0.0043 - 0.0064
1	NA	>0.0064 - 0.013
0.5	NA	>0.013 - 0.026
None (<0.5)	NA	>0.026

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects. An RfD is not available (NA) for this compound.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and a cancer slope factor (CSF) of 7.3 (mg/kg-d)⁻¹. No RfD was available (June 1999).
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for PAHs is 1 x 10⁻⁶ mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-24. Monthly Fish Consumption Limits for Carcinogenic and Noncarcinogenic Health Endpoints - PCBs

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b	Cancer Health Endpoints ^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppm, wet weight)
Unrestricted (>16)	0 - 0.0059	0 - 0.0015
16	>0.0059 - 0.012	>0.0015 - 0.0029
12	>0.012 - 0.016	>0.0029 - 0.0039
8	>0.016 - 0.023	>0.0039 - 0.0059
4	>0.023 - 0.047	>0.0059 - 0.012
3	>0.047 - 0.063	>0.012 - 0.016
2	>0.063 - 0.094	>0.016 - 0.023
1	>0.094 - 0.19	>0.023 - 0.047
0.5	>0.19 - 0.38	>0.047 - 0.094
None (<0.5)	>0.38	>0.094

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

* Concentration reported in parts per quadrillion (nanogram per kg or 10⁻⁹ g/kg).

Notes:

1. Consumption limits are based on an adult body weight of 70 kg, and RfD of 2x10⁻⁵, and a cancer slope factor (CSF) of 2 (mg/kg-d)⁻¹.
2. NONE = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for PCBs (sum of Aroclors) is 2 x 10⁻² mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).

4. RISK-BASED CONSUMPTION LIMIT TABLES

Table 4-25. Monthly Fish Consumption Limits for Carcinogenic Health Endpoint - Dioxins/Furans

Risk Based Consumption Limit ^a	Noncancer Health Endpoints ^b	Cancer Health Endpoints ^c
Fish Meals/Month	Fish Tissue Concentrations (ppm, wet weight)	Fish Tissue Concentrations (ppt*-TEQ, wet weight)
Unrestricted (>16)	NA	0 - 0.019
16	NA	>0.019 - 0.038
12	NA	>0.038 - 0.05
8	NA	>0.05 - 0.075
4	NA	>0.075 - 0.15
3	NA	>0.15 - 0.2
2	NA	>0.2 - 0.3
1	NA	>0.3 - 0.6
0.5	NA	>0.6 - 1.2
None (<0.5)	NA	>1.2

^a The assumed meal size is 8 oz (0.227 kg). The ranges of chemical concentrations presented are conservative, e.g., the 12-meal-per-month levels represent the concentrations associated with 12 to 15.9 meals.

^b Chronic, systemic effects. An RfD is not available (NA) for this compound.

^c Cancer values represent tissue concentrations at a 1 in 100,000 risk level.

* Concentration reported in parts per trillion (nanogram per kg or 10⁻⁹ g/kg)

Notes:

1. Consumption limits are based on an adult body weight of 70 kg and a cancer slope factor (CSF) of 1.56x10⁵ (mg/kg-d)⁻¹. No RfD available (June 1999).
2. None = No consumption recommended.
3. In cases where >16 meals per month are consumed, refer to Equations 3-1 and 3-2, Section 3.2.1.2, for methods to determine safe consumption limits.
4. The detection limit for dioxins/furans is 1 x 10⁻⁶ mg/kg.
5. Instructions for modifying the variables in this table are found in Section 3.3.
6. Monthly limits are based on the total dose allowable over a 1-month period (based on the RfD). When the monthly limit is consumed in less than 1 month (e.g., in a few large meals), the daily dose may exceed the RfD (see Section 2.3).



**Alaska Departments of Health & Social Services, Fish & Game, and
Environmental Conservation**

February 9, 2007

Alaska Fish Consumption Guidelines Under Development

Recommendations for women of childbearing years and young children may change

Eating Fish is Good For You

- Fish is an excellent source of lean protein, healthy omega-3 fatty acids, antioxidants, and vitamins.
- Fish is an important part of a healthy diet for everyone, including pregnant and nursing women, and young children.
- The health benefits of eating fish far outweigh any potential risk from minor amounts of contaminants in Alaska fish. If you are concerned about the mercury level in fish, your risk can be minimized by choosing fish lower in mercury, such as salmon.

New Research Creates Need to Re-evaluate Guidelines

- Recent data from the Department of Environmental Conservation fish monitoring program reveal a wide variation of mercury content among the 23 Alaska species sampled between 2004 and 2006. More than 2,200 fish have been sampled.
- At this time the Division of Public Health is considering adjusting fish consumption guidelines for women of childbearing years and young children, especially for fish with an average mercury level of greater than 0.4 ppm (parts per million). For comparison, a can of albacore tuna averages 0.407 ppm, a can of light chunk tuna averages 0.118 ppm.
- Fish with average mercury concentration above 0.4 ppm are lingcod, yelloweye rockfish, shark, spiny dogfish, and halibut over 50 lbs (average commercially caught halibut is 26 lbs).
- The primary concern would be for women of childbearing years or young children who would consume many portions from one large fish containing higher mercury levels.
- Health guidelines are expected to be completed by spring of 2007.

Testing Continues

- The Department of Environmental Conservation is continuing its fish monitoring program. The Division of Public Health will continue to evaluate the new data and refine any recommendations.
- Public Health continues its statewide hair mercury bio-monitoring program. The state encourages any Alaska woman of childbearing years to participate free of charge through her local health provider. To date, tests of 359 samples have revealed a median value of 0.53 ppm mercury in the hair of all women tested; far below the World Health Organization's "No Observed Effect" level of 14 ppm mercury in maternal hair.

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Alaska Department of Environmental Conservation Fish Monitoring Program
Total Heavy Metal Concentrations *(ppm) for Fish Species Collected

Update January 2007 *from 2001 cumulative*

	Number of fish	Mean	Std Dev	Median	Min	Max
DUSKY ROCKFISH						
Arsenic	6	0.347	0.079	0.348	0.225	0.447
Cadmium	6	< DL**		< DL**	< DL**	< DL**
Chromium	6	0.046	0.022	0.045	0.026	0.068
Lead	6	0.027	0.030	< DL**	< DL**	0.088
Nickel	6	0.041	0.025	< DL**	< DL**	0.073
Selenium	6	0.445	0.052	0.456	0.347	0.489
Total Mercury	6	0.097	0.107	0.061	0.026	0.309
PACIFIC OCEAN PERCH						
Arsenic	68	1.220	0.478	1.262	0.184	2.355
Cadmium	68	< DL**	< DL**	< DL**	< DL**	< DL**
Chromium	68	0.152	0.250	< DL**	< DL**	1.378
Lead	68	< DL**	< DL**	< DL**	< DL**	< DL**
Nickel	68	0.039	0.031	< DL**	< DL**	0.196
Selenium	68	0.477	0.173	0.424	0.252	1.028
Total Mercury	78	0.056	0.041	0.054	< DL**	0.262
YELLOWEYE ROCKFISH						
Arsenic	31	0.895	0.611	0.739	0.194	2.938
Cadmium	31	< DL**	< DL**	< DL**	< DL**	< DL**
Chromium	31	0.039	0.019	< DL**	< DL**	0.094
Lead	31	0.030	0.049	< DL**	< DL**	0.247
Nickel	31	0.029	0.014	< DL**	< DL**	0.088
Selenium	31	0.523	0.122	0.498	0.328	0.852
Total Mercury	31	0.513	0.286	0.466	0.144	1.263
SABLEFISH						
Arsenic	110	0.928	0.423	0.834	0.200	2.612
Cadmium	110	0.006	0.001	< DL**	< DL**	0.014
Chromium	110	0.045	0.093	< DL**	< DL**	0.723
Lead	110	< DL**	< DL**	< DL**	< DL**	< DL**
Nickel	110	0.029	0.024	< DL**	< DL**	0.249
Selenium	110	0.236	0.064	0.222	0.137	0.488
Total Mercury	191	0.182	0.192	0.107	< DL**	1.192

* Concentration expressed as ppm (parts per million, mg/kg)

** <DL: Below Detection Limit

Values below the Analytical Detection Limit are treated as 1/2 the Detection Limit for calculation purposes

Alaska Department of Environmental Conservation Fish Monitoring Program
Total Heavy Metal Concentrations *(ppm) for Fish Species Collected
Update January 2007

	Number of fish	Mean	Std Dev	Median	Min	Max
ALL SALMON						
Arsenic	455	0.345	0.206	0.289	0.110	1.647
Cadmium	455	0.007	0.005	< DL**	< DL**	0.082
Chromium	455	0.033	0.036	< DL**	< DL**	0.324
Lead	455	0.018	0.070	< DL**	< DL**	1.484
Nickel	455	0.033	0.040	< DL**	< DL**	0.373
Selenium	455	0.254	0.052	0.247	0.169	0.685
Total Mercury	765	0.040	0.021	0.038	< DL**	0.159
CHINOOK SALMON (KING)						
Arsenic	54	0.706	0.314	0.681	0.288	1.647
Cadmium	54	0.006	0.001	< DL**	< DL**	0.011
Chromium	54	0.026	0.004	< DL**	< DL**	0.052
Lead	54	< DL**	< DL**	< DL**	< DL**	< DL**
Nickel	54	< DL**	< DL**	< DL**	< DL**	< DL**
Selenium	54	0.262	0.052	0.252	0.189	0.385
Total Mercury	115	0.064	0.028	0.058	< DL**	0.159
CHUM SALMON						
Arsenic	122	0.237	0.125	0.207	0.112	1.103
Cadmium	122	0.007	0.009	< DL**	< DL**	0.082
Chromium	122	0.034	0.040	< DL**	< DL**	0.324
Lead	122	0.015	0.050	< DL**	< DL**	0.067
Nickel	122	0.033	0.043	< DL**	< DL**	0.373
Selenium	122	0.259	0.039	0.252	0.175	0.392
Total Mercury	174	0.043	0.015	0.041	< DL**	0.103
PINK SALMON						
Arsenic	66	0.321	0.136	0.288	0.138	0.845
Cadmium	66	< DL**	< DL**	< DL**	< DL**	< DL**
Chromium	66	< DL**	< DL**	< DL**	< DL**	< DL**
Lead	66	< DL**	< DL**	< DL**	< DL**	< DL**
Nickel	66	< DL**	< DL**	< DL**	< DL**	< DL**
Selenium	66	0.242	0.039	0.237	0.173	0.342
Total Mercury	120	0.019	0.010	< DL**	< DL**	0.064
RED SALMON (SCKEYE)						
Arsenic	119	0.286	0.064	0.285	0.136	0.473
Cadmium	119	0.007	0.003	< DL**	< DL**	0.029
Chromium	119	0.040	0.041	< DL**	< DL**	0.321
Lead	119	0.015	0.003	< DL**	< DL**	0.044
Nickel	119	0.038	0.050	< DL**	< DL**	0.285
Selenium	119	0.260	0.074	0.249	0.169	0.685
Total Mercury	202	0.038	0.015	0.038	< DL**	0.082

* Concentration expressed as ppm (parts per million, mg/kg)

** <DL: Below Detection Limit

Values below the Analytical Detection Limit are treated as 1/2 the Detection Limit for calculation purposes

Alaska Department of Environmental Conservation Fish Monitoring Program
Total Heavy Metal Concentrations *(ppm) for Fish Species Collected
Update January 2007

	Number of fish	Mean	Std Dev	Median	Min	Max
BURBOT						
Arsenic	7	0.277	0.230	0.218	0.059	0.775
Cadmium	7	< DL**		< DL**	< DL**	< DL**
Chromium	7	0.031	0.014	< DL**	< DL**	0.063
Lead	7	< DL**		< DL**	< DL**	< DL**
Nickel	7	0.029	0.010	0.025	< DL**	0.052
Selenium	7	0.360	0.129	0.309	0.230	0.566
Total Mercury	10	0.533	0.254	0.558	< DL**	0.854
PACIFIC COD						
Arsenic	57	5.917	3.067	5.290	1.209	13.137
Cadmium	57	< DL**		< DL**	< DL**	< DL**
Chromium	57	0.078	0.093	< DL**	< DL**	0.457
Lead	57	< DL**		< DL**	< DL**	< DL**
Nickel	57	0.038	0.038	0.025	< DL**	0.277
Selenium	57	0.237	0.053	0.223	0.158	0.422
Total Mercury	110	0.133	0.097	0.108	< DL**	0.496
GRAYLING						
Arsenic	7	0.019	0.006	0.021	0.010	0.026
Cadmium	7	< DL**		< DL**	< DL**	< DL**
Chromium	7	< DL**		< DL**	< DL**	< DL**
Lead	7	< DL**		< DL**	< DL**	< DL**
Nickel	7	< DL**		< DL**	< DL**	< DL**
Selenium	7	0.698	0.520	0.543	0.240	1.453
Total Mercury	7	0.090	0.028	0.088	0.057	0.141
HALIBUT						
Arsenic	391	1.450	0.981	1.205	0.157	6.054
Cadmium	391	0.006	0.000	< DL**	< DL**	0.013
Chromium	391	0.045	0.082	< DL**	< DL**	0.912
Lead	391	< DL**		< DL**	< DL**	< DL**
Nickel	391	0.027	0.019	0.025	0.025	0.279
Selenium	391	0.353	0.121	0.333	0.141	0.969
Total Mercury	643	0.325	0.290	0.222	< DL**	1.947

* Concentration expressed as ppm (parts per million, mg/kg)

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Alaska Department of Environmental Conservation Fish Monitoring Program
Total Heavy Metal Concentrations *(ppm) for Fish Species Collected
Update January 2007

LINGCOD	Number of fish	Mean	Std Dev	Median	Min	Max	
Arsenic	62	0.656	0.399	0.582	0.166	2.552	
Cadmium	62	< DL**	< DL**	< DL**	< DL**	< DL**	
Chromium	62	0.035	0.015	< DL**	< DL**	0.077	
Lead	62	0.016	0.005	< DL**	< DL**	0.053	
Nickel	62	0.026	0.006	< DL**	< DL**	0.070	
Selenium	62	0.388	0.070	0.382	0.259	0.622	
Total Mercury	75	0.490	0.364	0.502	0.033	1.428	
NORTHERN PIKE							
Arsenic	12	0.141	0.090	0.119	0.044	0.348	
Cadmium	12	< DL**	< DL**	< DL**	< DL**	< DL**	
Chromium	12	< DL**	< DL**	< DL**	< DL**	< DL**	
Lead	12	< DL**	< DL**	< DL**	< DL**	< DL**	
Nickel	12	< DL**	< DL**	< DL**	< DL**	< DL**	
Selenium	12	0.267	0.093	0.291	0.144	0.478	
Total Mercury	104	0.272	0.261	0.185	< DL**	1.202	
WALLEYE POLLOCK							
Arsenic	57	1.169	0.541	0.985	0.417	3.403	
Cadmium	57	< DL**	< DL**	< DL**	< DL**	< DL**	
Chromium	57	< DL**	< DL**	< DL**	< DL**	< DL**	
Lead	57	< DL**	< DL**	< DL**	< DL**	< DL**	
Nickel	57	0.026	0.005	< DL**	< DL**	0.062	
Selenium	57	0.227	0.042	0.230	0.147	0.356	
Total Mercury	143	0.052	0.067	< DL**	< DL**	0.389	
BLACK ROCKFISH							
Arsenic	21	0.376	0.115	0.360	0.165	0.638	
Cadmium	21	< DL**	< DL**	< DL**	< DL**	< DL**	
Chromium	21	0.040	0.035	< DL**	< DL**	0.158	
Lead	21	< DL**	< DL**	< DL**	< DL**	< DL**	
Nickel	21	0.032	0.017	< DL**	< DL**	0.089	
Selenium	21	0.487	0.106	0.472	0.308	0.721	
Total Mercury	26	0.134	0.076	0.106	0.044	0.349	

* Concentration expressed as ppm (parts per million, mg/kg)

** <DL: Below Detection Limit

Values below the Analytical Detection Limit are treated as 1/2 the Detection Limit for calculation purposes

Alaska Department of Environmental Conservation Fish Monitoring Program
Total Heavy Metal Concentrations *(ppm) for Fish Species Collected
Update January 2007

	Number of fish	Mean	Std Dev	Median	Min	Max
SILVER SALMON						
Arsenic	94	0.356	0.125	0.348	0.110	0.829
Cadmium	94	0.007	0.003	< DL**	< DL**	0.030
Chromium	94	0.036	0.044	< DL**	< DL**	0.324
Lead	94	0.031	0.152	< DL**	< DL**	1.484
Nickel	94	0.036	0.044	< DL**	< DL**	0.269
Selenium	94	0.244	0.038	0.242	0.177	0.340
Total Mercury	154	0.037	0.015	0.036	< DL**	0.113
SHARK						
Arsenic	9	1.360	0.510	1.403	0.680	2.431
Cadmium	9	0.014	0.011	< DL**	< DL**	0.032
Chromium	9	0.041	0.018	< DL**	< DL**	0.067
Lead	9	0.020	0.015	< DL**	< DL**	0.061
Nickel	9	< DL**	< DL**	< DL**	< DL**	< DL**
Selenium	9	0.248	0.026	0.242	0.204	0.291
Total Mercury	9	1.182	0.286	1.191	0.758	1.568
SPINY DOGFISH						
Arsenic	49	2.838	0.646	2.726	1.606	4.166
Cadmium	49	< DL**	< DL**	< DL**	< DL**	< DL**
Chromium	49	0.062	0.052	0.058	< DL**	0.273
Lead	49	0.020	0.022	< DL**	< DL**	0.154
Nickel	49	0.032	0.018	< DL**	< DL**	0.110
Selenium	49	0.184	0.021	0.184	0.146	0.227
Total Mercury	49	0.799	0.251	0.834	0.095	1.340
LAKE TROUT						
Arsenic	9	0.139	0.061	0.111	0.072	0.236
Cadmium	9	< DL**	< DL**	< DL**	< DL**	< DL**
Chromium	9	0.029	0.010	< DL**	< DL**	0.056
Lead	9	< DL**	< DL**	< DL**	< DL**	< DL**
Nickel	9	< DL**	< DL**	< DL**	< DL**	< DL**
Selenium	9	0.276	0.023	0.280	0.248	0.303
Total Mercury	9	0.303	0.126	0.323	0.113	0.455

* Concentration expressed as ppm (parts per million, mg/kg)

** <DL: Below Detection Limit

Values below the Analytical Detection Limit are treated as 1/2 the Detection Limit for calculation purposes

Element	Method	Description	Detection Limit: ppm (mg/kg)	Number of fish	Mean	Std Dev	Median	Min	Max
SILVER SALMON									
Arsenic	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.019	84	0.386	0.125	0.348	0.110	0.828
Cadmium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.012	84	0.007	0.003	<DL**	<DL**	0.030
Chromium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.051	84	0.037	0.044	<DL**	<DL**	1.484
Lead	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.030	84	0.038	0.038	<DL**	<DL**	0.289
Nickel	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.050	84	0.244	0.038	0.243	0.177	0.440
Selenium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.046	84	0.037	0.015	<DL**	<DL**	0.118
SHARK									
Arsenic	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.012	8	0.014	0.011	<DL**	<DL**	0.032
Cadmium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.012	8	0.020	0.015	<DL**	<DL**	0.061
Chromium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.051	8	0.248	0.028	0.194	0.134	0.281
Lead	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.030	8	0.182	0.038	0.162	0.134	0.281
Nickel	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.050	8	0.037	0.015	<DL**	<DL**	0.118
Selenium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.046	8	0.037	0.015	<DL**	<DL**	0.118
SPINY DOGFISH									
Arsenic	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.019	48	0.037	0.015	<DL**	<DL**	0.118
Cadmium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.012	48	0.014	0.011	<DL**	<DL**	0.032
Chromium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.051	48	0.037	0.044	<DL**	<DL**	1.484
Lead	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.030	48	0.038	0.038	<DL**	<DL**	0.289
Nickel	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.050	48	0.244	0.038	0.243	0.177	0.440
Selenium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.046	48	0.037	0.015	<DL**	<DL**	0.118
LAKE TROUT									
Arsenic	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.019	8	0.037	0.015	<DL**	<DL**	0.118
Cadmium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.012	8	0.014	0.011	<DL**	<DL**	0.032
Chromium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.051	8	0.037	0.044	<DL**	<DL**	1.484
Lead	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.030	8	0.038	0.038	<DL**	<DL**	0.289
Nickel	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.050	8	0.244	0.038	0.243	0.177	0.440
Selenium	EPA 6020A	Inductively Coupled Plasma/Mass Spectrometry	0.046	8	0.037	0.015	<DL**	<DL**	0.118
Mercury (total)									
EPA 7473		Thermal Decomposition, Amalgamation and Atomic Absorption	0.025	48	0.037	0.015	<DL**	<DL**	0.118

Alaska Department of Environmental Conservation Fish Monitoring Program
Total Mercury Concentration *(ppm) for fish species collected
Update January 2007

	Total	Mean (ppm)	Standard Deviation	Median (ppm)	Minimum (ppm)	Maximum (ppm)	Weight (pounds)	
							Min.	Max.
Pacific Cod	110	0.133	0.097	0.108	<DL	0.496	1.8	23.2
Pacific Halibut	643	0.325	0.290	0.222	<DL	1.947	13.4	289.7
Lingcod	75	0.490	0.364	0.502	0.033	1.428	2.6	56.2
Walleye Pollock	143	0.052	0.067	<DL	<DL	0.389	0.7	7.3
Sablefish	191	0.182	0.192	0.107	<DL	1.192	1.8	16.7
Black Rockfish	26	0.134	0.076	0.106	0.044	0.349	3.1	7.5
Dusky Rockfish	6	0.097	0.107	0.061	0.026	0.309	2.4	5.5
Pacific Ocean Perch	78	0.056	0.054	0.041	<DL	0.262	0.5	2.5
Rougheye Rockfish	21	0.234	0.195	0.167	0.077	0.870	1.3	4.6
Yelloweye Rockfish	31	0.513	0.286	0.466	0.144	1.263	4.4	19.8
Shark	9	1.182	0.286	1.191	0.758	1.568	6' 5.9" **	7' 9.7" **
Spiny Dogfish	49	0.799	0.251	0.834	0.095	1.340	4.2	8.4
All Salmon	765	0.040	0.021	0.038	<DL	0.159		
King Salmon	115	0.064	0.028	0.058	<DL	0.159	1.3	31.5
Chum Salmon	174	0.043	0.015	0.041	<DL	0.103	2.9	13.9
Pink Salmon	120	0.019	0.010	<DL	<DL	0.064	1.3	7.1
Red Salmon	202	0.038	0.015	0.038	<DL	0.082	0.9	9.8
Silver Salmon	154	0.037	0.015	0.036	<DL	0.113	1.1	15.4
Burbot	10	0.533	0.254	0.558	<DL	0.854	0.3	6.8
Northern Pike	104	0.272	0.261	0.185	<DL	1.202	0.2	6.7
Sheefish	8	0.136	0.057	0.120	0.092	0.262	5.9	17.2
Lake Trout	9	0.303	0.126	0.323	0.113	0.455	1.5	6
Rainbow Trout	6	0.210	0.036	0.200	0.172	0.258	0.7	1.3
Grayling	7	0.09	0.028	0.088	0.057	0.141	1.1	1.8

*Concentration expressed as ppm (parts per million, mg/kg)

Detection Limit: 0.025 ppm

Values below the Analytical Detection Limit are treated as 1/2 the Detection Limit for calculation purposes

<DL: Below Detection Limit

** : Value is Length (feet, inches), since Weight is not available for this species

SUBLEGALS

-WE HOOK THE NEWS THAT'S FIT TO NET-

Vol. 13, No. 03

1 February 2007

13:03/04. MERCURY IN FISH FINDINGS LEAVE MANY SURPRISED. The Environmental Protection Agency (EPA) and Oregon State University (OSU) partnered to conduct a large-scale four year study to determine a "snapshot" of the dispersal distances and contamination levels of mercury in fish species in the west. The researchers recently published the project results in the journal of *Environmental Science & Technology*. The results shocked many: mercury was detected in every fish caught in every river tested. The study area spanned 626 rivers in 12 states covering almost 190,000 miles. Fish were sampled randomly with 2,707 fish tested overall. However, no salmonids were sampled to ensure that the experiment did not negatively effect already struggling anadromous populations.

These results suggested an expansive non-point source of mercury entering the watersheds and riparian zones. Mercury is a naturally occurring element in the environment due to volcanic activity and geothermal springs. However, previous research concluded that 2/3rds of mercury currently in the atmosphere is from man-made sources, i.e. coal-burning power plants, waste incinerators, forest fires, and cement kilns. Therefore, mercury deposition, falling from the atmosphere to Earth as rain or snow, is likely responsible for the wide breadth of mercury contamination in fish species throughout the west.

The EPA previously established a mercury threshold at 0.3 parts per million in fish tissues as safe for human consumption. While the majority of fish surveyed contained mercury levels lower than this threshold, some did not. The surveys also discovered that larger piscivorous (fish eating) fish on average had higher levels of mercury, a phenomenon called bioaccumulation. Of the large piscivorous fish, such as northern pike, bass, walleye, and pikeminnow, more than 50% met or exceeded the EPA health standards threshold. The research team suggested limiting consumption of these species to one or two times per month, especially for pregnant women and children.

The project staff recommended contacting local state and county agencies for more information concerning local mercury contaminated fish warnings. In fact, in response to the study, the Colorado Department of Health enacted new mercury warnings and fish consumption advisories for five lakes and reservoirs. Colorado limits mercury levels to 0.5 parts per billion, and these species and water bodies exceeded the state threshold. The Colorado State health department began a five-year program to assess mercury levels in fish and streams of Colorado.

The results of the EPA/OSU study are far reaching, yet it is important to note that while mercury levels may be lower than human health risk levels of concern it still negatively affects the wildlife and habitat. Also the study did not determine local sources of mercury, an important action for local agencies to undertake. Researchers called for follow-up studies to be conducted every couple of years to determine if the levels of mercury in the system are increasing or decreasing over time.

Information about the mercury in fish study results can be found in the 23 January Jeff Barnard piece in the *San Francisco Chronicle* at <http://sfgate.com/cgi-bin/article.cgi?file=/n/a/2007/01/23/national/a171046S79.DTL>, or in the 24 January Richard L. Hill article in *The Oregonian* at www.oregonlive.com/news/oregonian/index.ssf?/base/news/1169612728115700.xml&coll=7.

Survey Finds Mercury in Fish in West

By JEFF BARNARD, AP Environmental Writer

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Scientists looking for fish tainted by mercury found them in every fish and every river they sampled across the West, suggesting that industrial pollution generated around the world is likely responsible for at least some of it.

The survey of 2,707 fish randomly collected from 626 rivers in 12 states represents the biggest regional sampling yet of mercury in fish in the West, said Spencer A. Peterson, senior research ecologist EPA's National Health and Environmental Effects Research Laboratory in Corvallis.

The findings by scientists from the EPA and Oregon State University were reported in this month's issue of the journal *Environmental Science & Technology* and came out of an EPA survey of various environmental factors in rivers conducted between 2000 and 2004.

Though the survey found some fish with elevated mercury levels, suggesting a local source such as an old mercury mine, most levels were low, in line with canned tuna found in grocery stores, said Alan T. Herlihy, associate research professor in the OSU Department of Fisheries and Wildlife.

No attempt was made to specifically link the mercury in the fish to mercury in the atmosphere, but the low but widespread levels suggest the mercury came from deposition — mercury in the atmosphere falling to the earth in rain and snow, Herlihy added.

While generally below levels considered unsafe for people to eat from time to time, the mercury could pose a danger to fish and wildlife that depend on fish for their diet, said Robert M. Hughes, a fisheries and wildlife research associate professor at OSU who took part in the study.

Levels were generally higher in fish-eating fish, such as bass, walleye and pike, than in insect-eating fish, such as trout.

"What's important to note is that the levels are below what we consider a health concern in most fish," said EPA spokeswoman Suzanne Ackerman.

Elevated mercury levels have been linked to learning disabilities and developmental delays in children and to heart, nervous system and kidney damage in adults. Out of concern for the health effects, several states and the federal government have taken steps to cap mercury emissions.

It has long been understood that industrial emissions, such as coal-fired power plants, are responsible for some percentage of the mercury found in fish, said Steve Lindberg, a retired research fellow from the Oakridge National Laboratory, who did not take part in the study. The question is how much.

About two thirds of the mercury circulating in the atmosphere is generally considered to come from industrial or human sources, with the rest from things like volcanoes and other geologic sources, Lindberg said.

Lindberg said he is involved in research that has been tracking specific isotopes of mercury introduced into a lake watershed in Canada as they show up in fish, and will go on to see how mercury levels in the fish react when the mercury is cut off.

"It does suggest that concentrations in fish from mercury from the atmosphere are highly responsive to the amount of mercury being deposited from the atmosphere," he said. "We would argue in support of the notion of reducing industrial emissions to reduce the concentrations of mercury in fish."

<http://sfgate.com/cgi-bin/article.cgi?f=/n/a/2007/01/23/national/a171046S79.DTL>

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Mercury found in all fish tested in the West

Dietary limits - The extent of the neurotoxin surprises Oregon scientists, who suspect the air is the source

Wednesday, January 24, 2007

RICHARD L. HILL

A sweeping study by Oregon scientists has found mercury-contaminated fish throughout the West.

FACTBOX

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In the most widespread survey of mercury in the nation's streams, four Corvallis researchers with the U.S. Environmental Protection Agency and Oregon State University sampled more than 2,700 fish in Oregon, Washington and 10 other Western

states. They found detectable -- and in some cases, high -- amounts of mercury in every fish sampled from 626 randomly selected rivers and streams that flow nearly 190,000 miles.

Although they found only a few fish with high enough mercury levels that could pose a risk to people who eat them frequently, the scientists suggested that consumers -- especially pregnant women and young children -- follow federal guidelines that limit intake of fish known to contain mercury. They, as well as federal officials, recommend calling state and county agencies for any advisories issued on locally caught fish.

The study found that the highest mercury concentrations were primarily in larger fish-eating species called "piscivores," comprising northern pike, bass, walleye and pikeminnow. The levels in more than half of the piscivore samples were similar to those found in cans of albacore or "white" tuna, for which federal officials already urge dietary limits. The EPA and the U.S. Food and Drug Administration recommend pregnant women eat no more than one 6-ounce can of albacore tuna each week.

Levels in trout and other salmonid species had far lower levels of mercury.

To the scientists, the findings signal more surprise than alarm.

"We found a relatively low concentration of mercury across a broad expanse," said Spencer Peterson, a research ecologist with the EPA in Corvallis. "I think the beneficial effects of eating fish outweigh the hazard potential."

But mercury levels varied by site and fish species. Nearly all fish contain trace amounts of mercury -- in a form called methylmercury -- that can accumulate over time in the flesh of long-lived fish such as piscivores.

Salmon not tested

The scientists did not test salmon -- which spend time in the ocean as well as inland rivers -- to avoid taking fish from protected populations of threatened or endangered species. The researchers speculate that mercury in salmon would be similar to the low levels found in trout.

Mercury is a neurotoxin. If consumed at high levels, it can impair the neurological systems of people and wildlife, especially in the infant and younger years. Mercury is emitted by natural sources such as volcanoes and geothermal springs -- making it a "background" element -- but also by coal-burning power plants, waste incinerators, forest fires and cement kilns.

Peterson and his colleagues, who report their findings this month in the journal *Environmental Science & Technology*, say most of the contamination appears to be from the movement of mercury in the atmosphere. "When we look at the entire West at these hundreds of sites, we're not seeing a lot of really high point-source signals," said Alan Herlihy, an OSU aquatic ecologist. "The mercury was at low levels everywhere, which means to me there's some sort of uniform source, and atmospheric deposition is something that would fit that."

Other exclusions

The survey did not examine local sources that might be involved in contamination. It also did not look at whether mercury has been increasing or decreasing in the streams.

"I was surprised that the mercury was everywhere and in measurable amounts," said Robert Hughes, an aquatic ecologist at OSU. "I'm concerned about fish-eating mammals and birds -- mink, otter, heron and osprey -- that depend on these fish, but I don't know how much they may be affected."

The EPA has set a threshold of concern for human health at 0.3 micrograms of mercury per gram -- or .3 parts per million -- of fish tissue. The survey found that only 2.3 percent of the streams had large -- 5 inches or longer -- trout and other salmonids with mercury levels at or above that level. The salmonids were found in 41 percent of the stream network.

However, large piscivores measuring 5 inches or more were found in only 10 percent of the streams, but more than half were at or exceeded the 0.3 level.

Sampling in '02, '04

In their sampling between 2000 and 2004, the researchers found only 13 fish from eight sites that had a high mercury concentration of 1 part per million or more.

Herlihy said two of those sites were in the Willamette River, one near Creswell and the other south of Corvallis. The fish were northern pikeminnow or largemouth bass.

"Our goal was to get a 'snapshot' of the extent and level of mercury contamination in streams across a wide area," Herlihy said. "That hasn't been done before. What we need to do now is do this on a regular basis, say every five years."

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Alaska Department of Environmental Conservation Fish Monitoring Program: Analysis of Organic Contaminants

The natural resources of the State provide a rich bounty of foods for Alaskan residents as well as the rest of the world. There has been a concern that Persistent Organic Pollutants (POPs) have been identified across the globe including Arctic climates and may negatively impact the environment. These pollutants can travel great distances in the atmosphere and in ocean currents from their source of origin, they resist chemical breakdown and bioaccumulate in the food chain. Limited sampling of Alaskan fishes for these contaminants has not found levels of concern, but questions about the safety of eating fish from the North Pacific still arise. Alaska Department of Environmental Conservation (ADEC) developed the Fish Monitoring Program in order to conduct a more rigorous examination of contaminant levels in Alaskan fishes. The program involves a general survey of selected marine and freshwater finfish species from around the state and testing these fishes for certain environmental contaminants.

In a collaborative effort with biologists from the Alaska Department of Fish and Game, the U.S. National Oceanic and Atmospheric Agency (NOAA), the International Pacific Halibut Commission (IPHC) and commercial and some Native fishermen, samples of salmon (all 5 species), halibut, Pollock, sablefish, Pacific cod, lingcod and rockfish were collected from primarily marine waters and at the mouth of rivers through out the state. Northern pike were caught from lakes and rivers in the Koyukuk, Kuskokwim, Yukon and Susitna River drainages and sheefish from rivers draining in to Kotzebue Sound. Sheefish were collected in the winter of 2001 while the majority of the remaining fish were collected during the 2002 fishing season (June through August).

All samplers were trained to follow the standard protocol written in the Quality Assurance Project Plan to assure quality samples were submitted for analysis. Fish were caught, labeled, put in food grade plastic bags (fish sleeves) and placed in wetlock boxes. The samples were immediately shipped on ice, or frozen and then shipped to the Environmental Health Laboratory (EHL) in Palmer, Alaska. Over 600 samples were collected during this initial collection period. The fish were processed at EHL lab and chemical analysis was performed on the homogenized skinless fillets of individual fish. All of the fish samples were tested for heavy metals at the EHL Lab (methyl mercury, cadmium, lead, nickel, chromium, arsenic and selenium). Results for the heavy metal analysis can be found on the State web page:

<http://www.state.ak.us/dec/eh/vet/fish.htm> . These initial data support the Public Health Division's recommendation that all Alaskans, including pregnant women, women of childbearing age, and young children, continue unrestricted consumption of fish from Alaska waters

http://www.epi.hss.state.ak.us/bulletins/docs/b2001_06.htm .

Due to the high cost for the analysis of organic contaminants only a subset of all the fish samples were analyzed for polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and organochlorine pesticides using approved USEPA Methods by AXYS Analytical Services Ltd. (AXYS) in British Columbia, Canada. Data results from AXYS were validated by an independent contractor using USEPA Region 10 Validation Methods. This subset of fish did not include all species collected during the study period. This report will present the data from 89 fish samples (18 chum, 17 Chinook, 24 sockeye, 11 halibut, 8 sheefish and 11 sablefish).

Table 1 Sample size by general area where the fish were collected.

Species (# of fish)	Gulf of Alaska	Bering Sea	Freshwater Drainage Kotzebue Sound
Chum (18)	0	18	
Chinook (17)	9	8	
Sockeye (24)	12	12	
Halibut (11)	11		
Sablefish (11)	11		
Sheefish (8)			8



The fishes evaluated in this study occupy different positions in the Alaskan ecosystem. Salmon are anadromous fish, born in fresh water streams they migrate out to mature in the North Pacific and return to their birth stream to spawn. Chinook salmon, Alaska's State fish, is the largest and the most long-lived of the Pacific salmon species and is known for its high oil content. Sockeye are an important commercial species which, like the Chinook, contain a high oil

content. Native fishermen harvest all species of salmon, which is the main protein source for traditional diet. Sheefish live in arctic rivers and annually migrate up stream to spawn. They are a favorite food for many Native communities and often pursued by recreational fishermen. Halibut are bottom fish found along the Pacific Coast from Washington State to the Bering Sea, as far north as Norton Sound. Like salmon, halibut are important to commercial, subsistence and recreational fisheries. Sablefish (also known as blackcod or butterfish) have a high oil content and range in the deep waters of the North Pacific from Western Canada to the Bering Sea. Generally, Sablefish are commercially harvested year-round from the Gulf of Alaska and Western Canada.

Table 2 Range, mean and standard deviation of the weight in kilograms (kg) of the fish collected

<u>Weight (Kilograms)</u>				
<u>Species (# of fish)</u>	<u>Mean</u>	<u>Std. Dev</u>	<u>Min</u>	<u>Max</u>
Chum (18)	3.47	0.82	2	5.4
Chinook (17)	5.6	2.64	2.3	13.8
Sockeye (24)	2.6	0.67	1.6	4
Halibut (11)	20.6	11.17	9.1	41.4
Sablefish (11)	1.3	0.35	0.8	1.7
Sheefish (8)	4.3	1.8	2.7	7.8

The oil or lipid concentrations vary considerably for different species of fish. The polyunsaturated fatty acids and omega 3 fatty acids contained in fish are responsible for many of the health benefits such as improved cardiovascular function and are essential for a healthy pregnancy and fetal neurodevelopment. Many of the organic contaminants are lipophilic and bioaccumulate in the fat component of the fish and it is important to know the relative lipid content of the different species when comparing the contaminant concentrations. As expected older and larger fish with higher percent lipid concentration would be expected to accumulate higher levels of organic contaminants. The percent lipid concentration of the fish analyzed is presented in Table 3.

Table 3 Lipid Concentration of Skinless Fillet tissue

<u>% Lipid Concentration</u>				
<u>Species (# fish)</u>	<u>Mean</u>	<u>Std Dev</u>	<u>Min</u>	<u>Max</u>
All Salmon (59)	7.29	4.24	1.98	23.6
Chum (18)	4.81	1.44	2.86	8.9
Chinook (17)	8.6	5.79	1.98	23.6
Sockeye (24)	8.22	3.67	2.17	16.1
Halibut (11)	0.46	0.25	0.15	0.9
Sablefish (11)	3.17	2.19	0.79	6.61
Sheefish (8)	1.47	0.74	0.22	2.89

Due to the limited sample numbers analyzed in this study and presented in this initial report correlations of contaminant concentration to physical parameters (weight, sex, age) and location were not performed.

Analytical Data results:

PCB Concentration-

The PCB concentration of the fish tissue (individual fish, homogenized skinless fillet) is reported as total PCBs ppb (parts per billion) or ng/g wet weight, which is the sum of 44 PCB congeners, eight of which were co-eluting congeners, are quantified. The list of congeners can be found in an attached Table 8 in the appendix to this report; co-eluting congeners are listed separated by a comma. These PCB congeners include the 12 designated by the World Health Organization to be the greatest of public interest, 14 being measured by the Arctic Monitoring and Assessment Program and the 26 congeners that the FDA considers important to assess in foods. The PCB congeners are listed using the International Union of Pure and Applied Chemistry (IUPAC) nomenclature. Table 4 lists the range of values, the mean and standard deviation of the PCB concentration for the three salmon species (chum, Chinook, sockeye) grouped together and then individually for each species.

Table 4 Total PCB concentrations in fish tissue sampled*

<u>SPECIES</u>	<u># Fish</u>	<u>Total PCB ppb (ng/gm)</u>			
		<u>Mean</u>	<u>Std dev</u>	<u>Min</u>	<u>Max</u>
All SALMON	59	7.19	4.87	1.59	18.78
Chum	18	2.52	1.20	1.59	6.21
Chinook	17	8.17	4.58	4.11	18.02
Sockeye	24	10.00	4.26	3.00	18.78
Halibut	11	1.15	0.94	0.30	3.12
Sablefish	11	4.79	3.87	0.67	13.53
Sheefish	8	2.47	1.17	0.62	3.88

All samples below the detection limit are reported as zero for the calculations
Mean of the Sample Specific Detection Limit** for individual PCB congeners was 0.1958 pg/gm wet wt

* Total PCBs based on the sum of 44 Congeners listed in appendix

** [The sample specific detection limits are determined for each individual sample from the data during the chemical analysis using lab reagent blanks and adjusting for sample volume. This converts the signal of the instrument measuring the chemical to a numerical concentration by comparison to a known chemical standard.]

Dioxin Concentration-

The dioxin concentration in the fish tissue (individual fish, homogenized skinless fillet) is represented as Toxic Equivalent Quotients (TEQs) ppt (parts per trillion) or (pg/g wet weight). The calculation of the TEQ includes the concentration of dioxins, furans and dioxin-like PCBs using World Health Organization Toxic Equivalency Factors (Van den Berg et al. 1998). Table 5 illustrates the mean and standard deviation of the TEQ for the salmon species (chum, Chinook, sockeye) grouped together and then for each species separately.

Table 5 Toxic Equivalency Quotient (TEQ) concentration based on PCDDs, PCDFs, and Dioxin-like PCBs *

TEQ ppt (pg/gm wet weight)

SPECIES	# Fish	Mean	Std dev	
ALL SALMON	59	0.4411	0.368	
Chum	18	0.1062	0.0901	
Chinook	17	0.3971	0.2685	
Sockeye	24	0.7234	0.3362	The fraction of TEQ attributed to co-planer PCB for salmon averages 65%
Halibut	11	0.0198	0.0224	The fraction of TEQ attributed to co-planer PCB for halibut averages 94%
Sablefish	11	0.139	0.1237	The fraction of TEQ attributed to co-planer PCB for sablefish averages 90%
Sheefish	8	0.0872	0.0528	The fraction of TEQ attributed to co-planer PCB for sheefish averages 97%

All samples below the detection limit are reported as zero for the calculations

Mean Sample Specific Detection Limit for individual PCB congeners = 0.1958 pg/gm wet wt

Mean Sample Specific Detection Limit for individual Dioxin and Furan congeners = 0.0487 pg/gm wet wt

* TEQ calculated using WHO Toxic Equivalency Factors (Van den Berg 1998)

Pesticide Concentration-

Forty (40) pesticides were measured in each tissue sample. Several pesticides that were not detected in a majority of the fish samples collected. Table 6 lists the 13 pesticides that were not detected in over 75 % of the fish samples of all fish species. The mean sample specific detection limit and maximum concentration that was detected in the few samples is also illustrated. The data for these pesticides will not be illustrated in any of the summary tables. There were additional pesticide compounds that were not detected in over 75% of the fish samples in an individual species. These pesticide compounds will be listed separately at the bottom of the species table.

Table 6

Non-Detects found in > 75% of samples of all species Max Concentrations for each pesticide listed

Pesticide	Mean Sample Specific Detection Limit (ppb)	#Detected	Max
1,2-Dichlorobenzene	0.1000	2	1.3900
1,2,3-Trichlorobenzene	0.0525	1	0.1200
1,3,5-Trichlorobenzene	0.0502	0	ND
Aldrin	0.0787	0	ND
alpha-Endosulphan	0.0604	3	0.0649
beta-Endosulphan	0.0784	0	ND
Endrin Aldehyde	0.2405	0	ND
Endrin Ketone	0.0941	0	ND
HCH, delta	0.1196	3	0.8580
Heptachlor	0.1592	1	0.1130
Hexachlorobutadiene	0.0236	0	ND
Methoxychlor	0.2601	0	ND
Oxychlorane	0.3661	3	0.2350

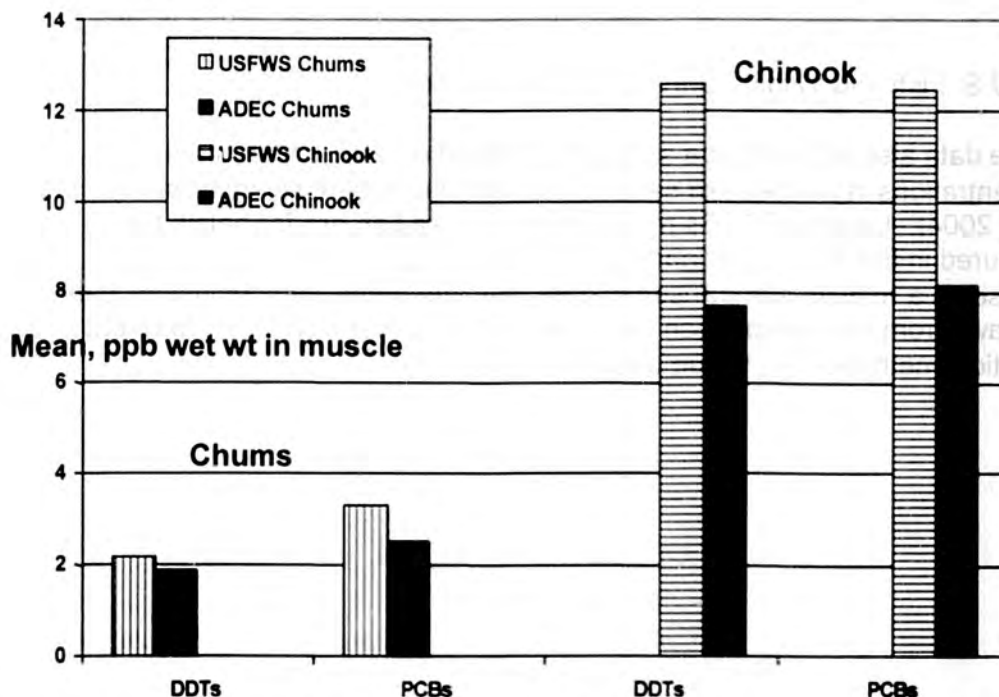
*ND=not detected

Appendix tables 7 A-G list the mean, standard deviation and range for each pesticide concentration detected by species and for chum, Chinook and sockeye salmon combined. Pesticide concentrations are reported as ppb (parts per billion) ng/gm wet weight. Data are calculated only for individual fish samples with a reportable concentration above the detection limit (all non-detects are treated as a zero value and are not included in the calculation. A footnote for each table will list the specific pesticides that were not detected in over 75% of all the tissue samples for that particular species.

Discussion

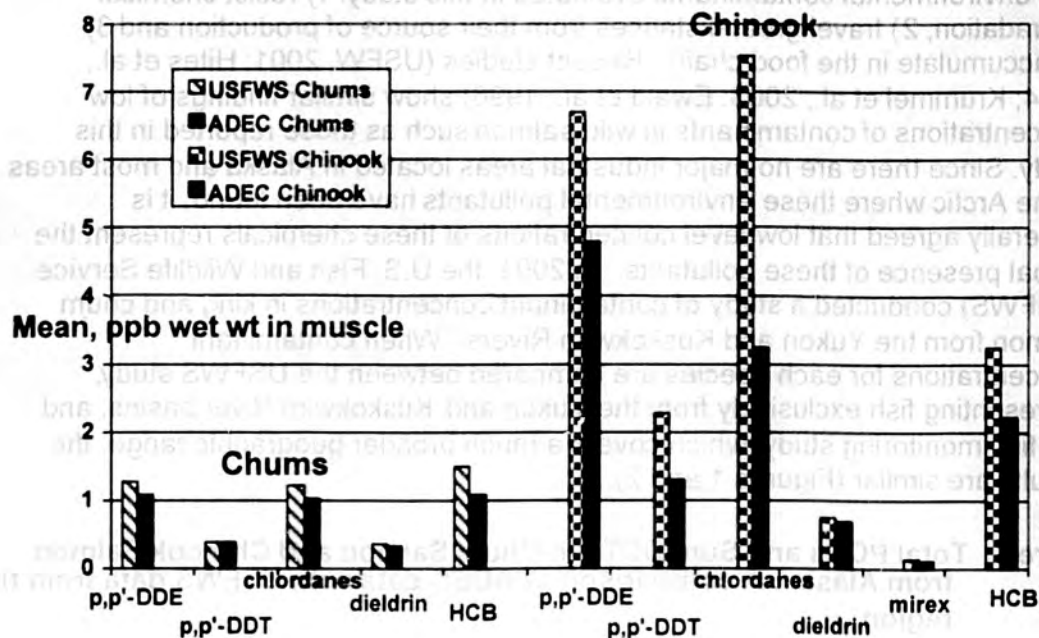
The environmental contaminants evaluated in this study: 1) resist chemical degradation, 2) travel great distances from their source of production and 3) bioaccumulate in the food chain. Recent studies (USFW, 2001; Hites et al., 2004; Krummel et al., 2003; Ewald et al., 1996) show similar findings of low concentrations of contaminants in wild salmon such as those reported in this study. Since there are no major industrial areas located in Alaska and most areas of the Arctic where these environmental pollutants have been found, it is generally agreed that low level concentrations of these chemicals represent the global presence of these pollutants. In 2001, the U.S. Fish and Wildlife Service (USFWS) conducted a study of contaminant concentrations in king and chum salmon from the Yukon and Kuskokwim Rivers. When contaminant concentrations for each species are compared between the USFWS study, representing fish exclusively from the Yukon and Kuskokwim River basins, and our fish monitoring study, which covers a much broader geographic range, the results are similar (Figures 1 and 2).

Figure 1. Total PCBs and Sum DDTs in Chum Salmon and Chinook Salmon from Alaska: A comparison of ADEC data with USFWS data from the Y-K region



* [1] U.S. Fish and Wildlife Service, unpublished data

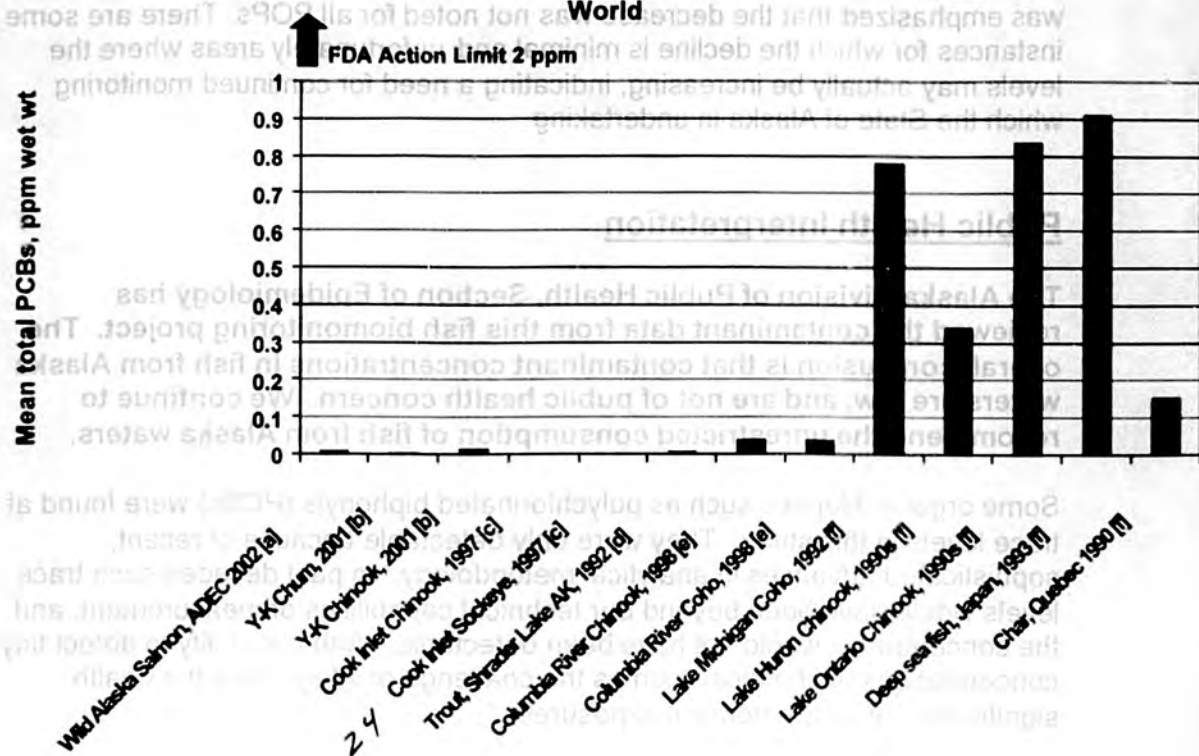
Figure 2. Organochlorine Pesticides in Chum Salmon and Chinook Salmon from Alaska: A Comparison of ADEC data with USFWS data from the Y-K Region ¹



* [1] U.S. Fish and Wildlife Service, unpublished data

These data also appear to be similar to graphed organic contaminant concentrations in wild Alaska salmon from another recent scientific study (Hites et al., 2004). Levels of PCBs measured in Alaska fish are far below those measured in fish from other parts of the world (Fig. 3). Note that Figure 3 represents a relative comparison of data only and definitive conclusions cannot be drawn from this comparison since each study could have used different analytical methodology, tissue used for analysis etc.

Figure 3. Comparison of PCB Levels in Fish from Alaska vs. Other Parts of the World



- [a] Three salmon species combined, this study
 [b] USFWS, unpublished data
 [c] EPA Cook Inlet Study 1998
 [d] Wilson et al., 1995
 [e] EPA Columbia River Study, 2002
 [f] ATSDR, 2000

Small differences in mean chemical concentrations in a particular fish species among Alaska studies (i.e. studies a, b, c and d listed above) may be due in part to differences in analytic methodology or other technical aspects of the studies. Due to their chemical properties, organochlorine concentrations in fish are influenced by many factors such as age, season, condition, and amount of fat stores. Any slight differences in chemical concentrations in a fish species among Alaska studies are probably due to both differences analytical methods and differences in biological factors, and are not indicative of localized sources of contamination. It should be noted that some of these Persistent Organic Pollutants (POPs), such as PCBs, and DDTs, have been banned from industrial production in the U.S. for many years. So even though these compounds were detected in small amounts in the fish tissue collected in this project as well as fish in other studies it is expected that their concentrations will continue to decrease.

This general trend has been noted in the most recent report of the Arctic Monitoring and Assessment Program (AMAP) (2002, AMAP Report). However, it was emphasized that the decrease was not noted for all POPs. There are some instances for which the decline is minimal and unfortunately areas where the levels may actually be increasing, indicating a need for continued monitoring which the State of Alaska is undertaking.

Public Health Interpretation

The Alaska Division of Public Health, Section of Epidemiology has reviewed the contaminant data from this fish biomonitoring project. The overall conclusion is that contaminant concentrations in fish from Alaska waters are low, and are not of public health concern. We continue to recommend the unrestricted consumption of fish from Alaska waters.

Some organochlorines such as polychlorinated biphenyls (PCBs) were found at trace levels in this study. They were only detectable because of recent, sophisticated advances in analytical methodology. In past decades such trace levels would have been beyond our technical capabilities of measurement, and the concentration would not have been detectable. With our ability to detect tiny concentrations of chemicals comes the challenge of interpreting the health significance of small chemical exposures.

Several U.S. government agencies provide guidelines for assessing the safety of consuming fish or other food products that contain trace levels of contaminants. The U.S. Food and Drug Administration (FDA) has established legal tolerances for the maximum levels of contaminants allowed in foods sold in commerce in the U.S. All levels of contaminants found in fish from this study were more than 100-fold lower than those legal tolerances.

The U.S. Environmental Protection Agency has established guidelines to assist states in evaluating contaminant levels in sport-caught and subsistence fish, and utilizing that information to develop fish consumption advice. These guidelines consist of four stages: sampling and analysis (USEPA, 2000a), risk assessment (USEPA, 2000b), risk management (USEPA, 1996), and risk communication (USEPA, 1995). EPA's risk assessment guidelines offer conservative guidelines for screening contaminant concentrations for potential health risks. If screening values are exceeded, local risk management is an important next step. In the risk management phase, local information and circumstances such as the health benefits of fish consumption, the social, cultural and economic importance of fish, and the health risks of alternative replacement foods must be considered to develop the best overall public health advice.

We have compared the fish contaminant data from this study to the EPA's screening criteria for recommended levels of fish consumption. For many

chemicals, the EPA offers two sets of screening guidelines based on two different health endpoints: chronic health effects and cancer. Both sets of guidelines were considered when available, but the Alaska Division of Public Health places more weight on the chronic health effect guidelines for a number of scientific reasons. EPA cancer guidelines are designed to be very conservative, and are likely to overestimate actual risk. Also, they do not take into account the growing body of research showing that fish consumption actually protects against some forms of cancer (Terry et al., 2003). We are concerned that populations who decrease their level of fish consumption might actually experience an increased incidence of cancer.

EPA's chronic health guidelines consider possible reproductive and developmental effects during the most sensitive life-stage for many of these chemicals: the developing fetus. They are conservative numbers that employ large safety factors. For example, reference doses (the maximum dose of a chemical that EPA deems safe to intake every day for a lifetime of 70 years) are often 100- to 1000-fold below the concentrations that have produced observable health effects in laboratory animals.

Results

Average organochlorine concentrations in skinless fillets are presented for each fish species tested in Tables 4,5,7 A-G. Federal risk assessment guidance was not available for all chemicals tested. Results with sufficient risk assessment information available are discussed in the section that follows.

Many pesticides tested were present in fish at low levels or were not detected, and were far below EPA guidelines for unrestricted consumption (defined by EPA as more than 16- 8 ounce meals per month). These pesticides included chlordanes, endrin, aldrin, endosulphans, hexachlorobutadiene, methoxychlor, heptachlor, hexachlorobenzene, lindane and mirex (Figures 4 and 5).

Figure 4. Endrin, Toxaphene, Lindane and Mirex in Chinook and Sockeye Salmon from Alaska - Comparison with EPA Guidelines (chronic) for Unlimited Consumption

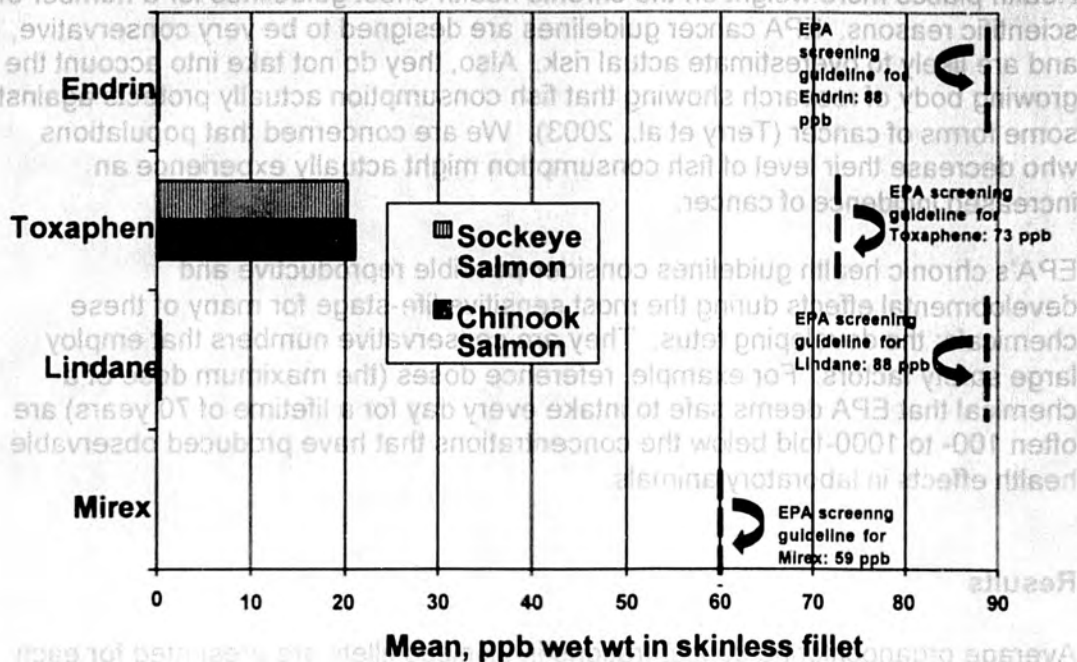
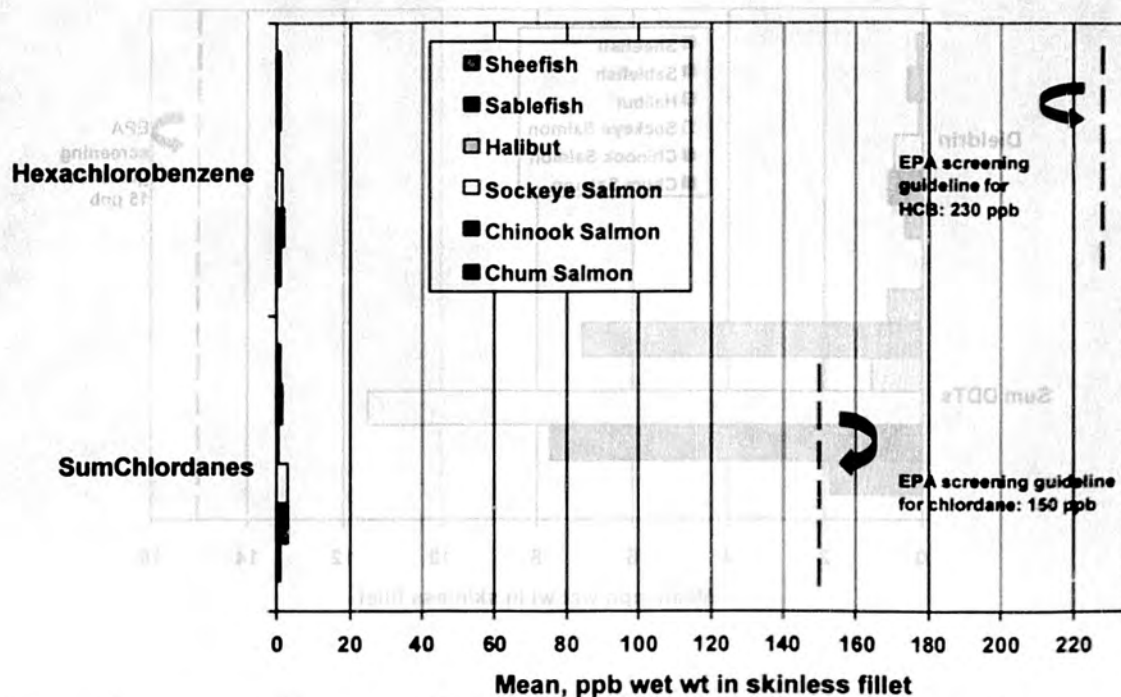
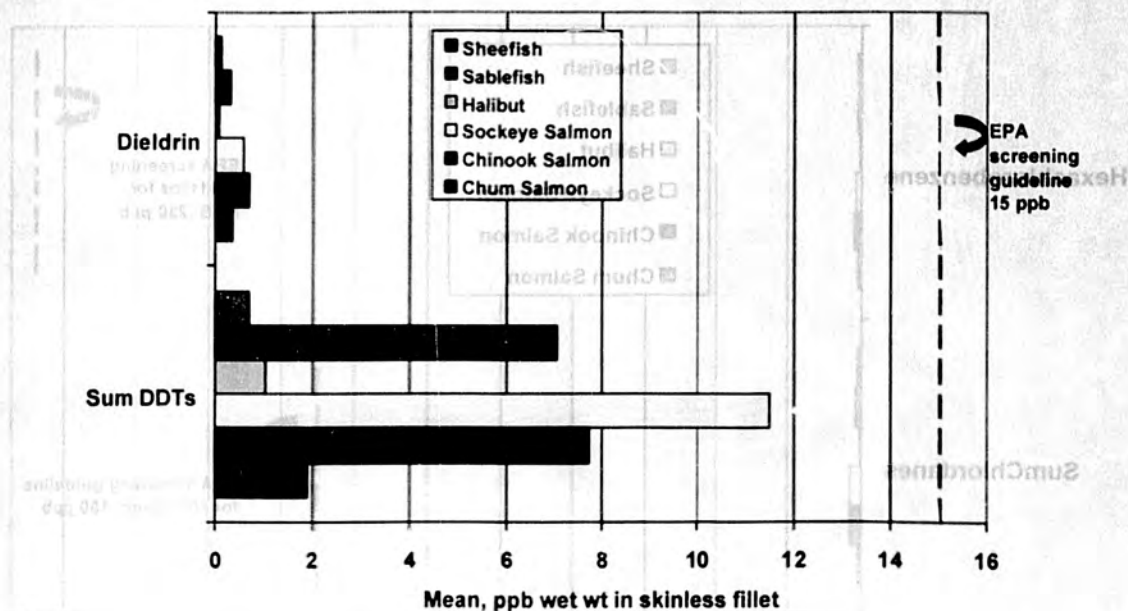


Figure 5. Hexachlorobenzene and SumChlordanes in Alaska Fish - Comparison with EPA Guidelines (chronic) for Unlimited Consumption



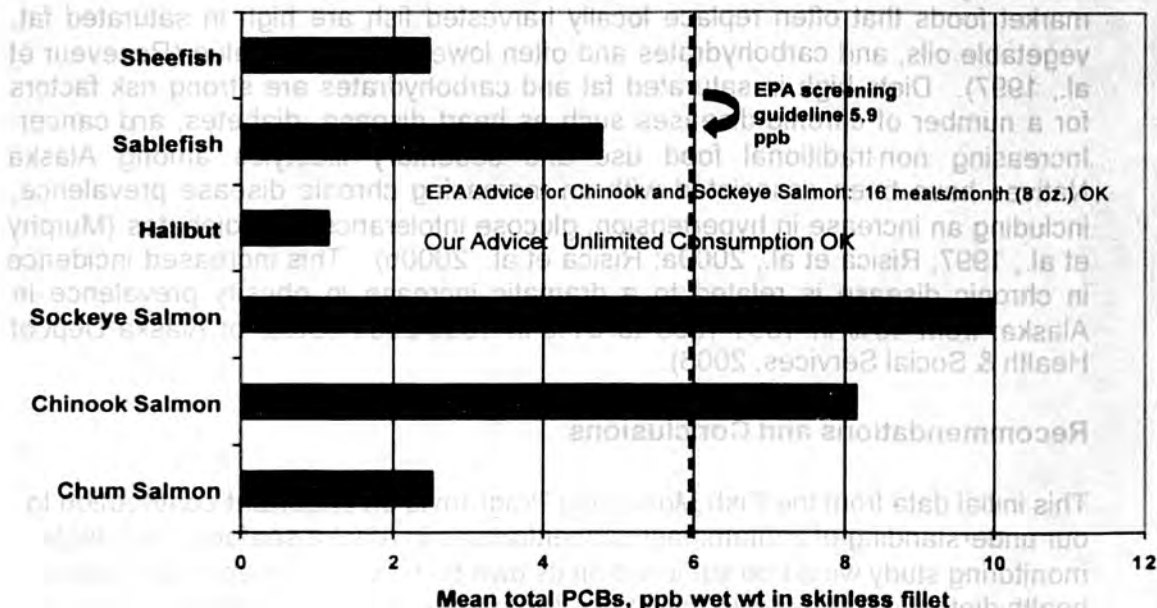
Several pesticides were detected in many of the fish tested, in small amounts below the EPA screening guidelines for unrestricted consumption using a chronic health endpoint. These pesticides include sum-DDTs, dieldrin, toxaphene, and several hexachlorocyclohexane isomers (Figures 4 and 6).

Figure 6. Dieldrin and SumDDTs in Fish from Alaska - Comparison with the EPA Guideline (chronic) for Unrestricted Consumption



Small amounts of polychlorinated biphenyls (PCBs) were also measured in most fish. Average "total PCB" levels for most fish species tested below EPA screening guidelines for unrestricted consumption using a chronic health endpoint (Fig. 7).

Figure 7. Comparison of PCB Levels in Salmon with the EPA Guideline for Unrestricted Consumption (chronic) - ADEC Fish Monitoring Project



Average PCB levels for Chinook and sockeye salmon exceeded the screening guideline. Without the benefit of local risk management, the EPA screening guidelines would recommend that an adult eat no more than 16 meals per month of Chinook or sockeye salmon based on a chronic health endpoint. However, the EPA guideline is only a screening tool used as part of a balanced benefit/risk analysis. The EPA reference dose for PCBs, upon which that calculation was based, incorporates a 300-fold safety factor below the lowest dose at which subtle health effects have been seen in the offspring of laboratory monkeys fed PCBs. In addition, Health Canada's daily intake guideline for PCB's is 50x greater (1ug/kg-body weight/day) than EPA's (0.02 ug/kg-body weight/day) suggesting much more than 16 meals per month can be safely consumed. Given EPA's safety factor and considering the many health benefits of fish consumption (illustrated in the next section), the Alaska Division of Public Health continues to recommend the unrestricted consumption of fish caught from Alaska waters, including Chinook and sockeye salmon.

The Health Benefits of Fish Consumption

In developing public health advice about the dietary intake of fish, it is crucial to consider both the benefits and the risks of fish consumption. Fish are a very nutritious protein source that is low in saturated fat, providing essential fatty acids, antioxidants and vitamins. Alaska salmon and other fatty fish are excellent sources of omega-3 fatty acids, which provide many health benefits including protection from diabetes and cardiovascular disease, and improved maternal nutrition and neonatal/infant brain development.

When evaluating the health implications of reduced fish consumption, it is also necessary to consider the health risks of alternative replacement foods. The market foods that often replace locally harvested fish are high in saturated fat, vegetable oils, and carbohydrates and often lower in nutrient value (Receveur et al., 1997). Diets high in saturated fat and carbohydrates are strong risk factors for a number of chronic diseases such as heart disease, diabetes, and cancer. Increasing non-traditional food use and sedentary lifestyles among Alaska Natives have been associated with an increasing chronic disease prevalence, including an increase in hypertension, glucose intolerance, and diabetes (Murphy et al., 1997; Risica et al., 2000a; Risica et al., 2000b). This increased incidence in chronic disease is related to a dramatic increase in obesity prevalence in Alaska: from 48% in 1991-1993 to 61% in 1999-2001 (State of Alaska Dept. of Health & Social Services, 2003).

Recommendations and Conclusions

This initial data from the Fish Monitoring Program is an important contribution to our understanding of contaminant concentrations in Alaska seafood. No single monitoring study would be sufficient on its own to derive comprehensive public health dietary guidelines. In this study, the sample size was relatively small, only a few fish species were analyzed, and the fish were of a size range that may or may not be representative of the fish most commonly consumed. However, the results of this study add to a significant body of evidence that already exists, and that is rapidly expanding, regarding contaminant levels in the Alaskan environment and its people.

The data from this study are consistent with other recent fish monitoring studies, which lends considerable weight to the results. Recent, ongoing human monitoring projects also provide important exposure information to optimize and validate our consumption advice, including the Alaska Native Tribal Health Consortium's maternal-infant cord blood study and our maternal hair mercury biomonitoring program (Alaska Division of Public Health, 2003).

Taken together, the growing body of information about contaminant levels in food and humans, disease incidence and trends in Alaska, and health benefits of fish and other wild foods, provide a foundation upon which to base our public health dietary advice. The Alaska Division of Public Health and the Alaska Department of Environmental Conservation provide the following conclusions and recommendations:

- Fish is a very nutritious protein source that is low in saturated fat, providing essential fatty acids, antioxidants and vitamins. It is far more healthful than many alternative replacement foods.

- Organochlorine contaminant concentrations in Alaska fish are low, and are not expected to cause adverse health effects in even the most frequent fish consumers.
- The Alaska Division of Public Health continues to recommend the unrestricted consumption of fish from Alaska waters.
- Ongoing monitoring is needed to better understand the factors influencing contaminant concentrations in Alaska fish and wildlife, actual exposure levels in humans who consume wild foods, and trends in contaminant concentrations over time.

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* PCB congeners listed are based on IUPAC nomenclature. Congeners listed together co-elute.

Appendix:

Table 8 Congener List

PCB Congeners used to calculate Total PCB *

18	86	135,151	178
20,28	90,101	137	180
37	93,95	146	183
44	105	147,149	187
49	110	153	189
52	114	156	194
61	118	167	195
66	123	169	196
77,74	126	170	201
81	128	172	206
83,99	129,138	177	209

* PCB congeners listed are based on IUPAC nomenclature. Congeners listed together co-elute.

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State cites mercury in some Alaska fish

FIVE SPECIES: For good health, kids and pregnant women are advised to limit amounts.

By ROSEMARY SHINOHARA

Anchorage Daily News

(Published: February 4, 2007)

Samples from five types of Alaska fish contain too much mercury for unlimited eating, according to new data gathered by the state.

State health officials say the fish -- halibut over 50 pounds, shark, lingcod, yellow eye rockfish and spiny dogfish -- are safe to eat in normal helpings for most people. But they might not be OK for pregnant women and small children to consume in large quantities, officials said, and they're drawing up new guidelines.

"Our largest, most important recommendation is, we want people to eat fish because fish is really good for you," said Lori Verbrugge, a toxicologist with the state Department of Health and Social Services.

That message was underscored by the way the state delivered the news last week: in an announcement from the governor's office, including a quote from Gov. Sarah Palin that she loves Alaska seafood and "will continue to enjoy it on a regular basis."

All varieties of salmon tested low for mercury. Chow down.

"Don't shy away from all halibut either," Verbrugge said. "The real concern with halibut is a person who catches one large halibut that happens to contain a lot of mercury, and they're eating off it all year."

Mostly larger, older halibut tested high for mercury, she said.

The state has not yet revised its guidelines on how much of the higher-mercury fish anyone should eat but will within a few weeks, Verbrugge said. First, the state will take the data to groups of subsistence users, charter fishing operators and others for review.

For the past several years, the state health department has advised that people could safely eat an unrestricted amount of fish caught in Alaska waters, even while the federal government urged that women of childbearing age and young children eat only two meals of fish low in mercury per week to limit exposure.

Studies have shown that mercury can subtly affect children's brain development so they might have minor learning difficulties or a slight drop in IQ, Verbrugge said.

During the past two years, the state has updated and expanded its testing of about two dozen fish varieties, said Dr. Bob Gerlach, a veterinarian with the state Department of Environmental Conservation, who runs the fish monitoring project.

Study participants from fish biologists to subsistence fishermen have sent in about 2,800 samples

so far and the tests are continuing, Gerlach said.

He analyzes skinless filets, which are what most people eat, he said.

Top predator fish, which eat smaller fish, and older fish tend to have higher levels of mercury, he said.

Fish containing mercury concentrations of less than one part per million are considered to have no effect on people.

Some salmon, which are 1 to 6 years old when harvested, had so little mercury that it didn't register, he said.

Lingcod, which can live to be as old as 25, contained an average of .5 parts per million of mercury and a maximum of 1.4 parts per million.

Only nine sharks were tested, but they were all high in mercury, ranging from .8 to 1.6 parts per million.

Of the other high-mercury fish:

- Levels in halibut depended on size. "If you catch a 90-pound or larger halibut, you have about a 33 percent chance that it will have 1 part per million," Verbrugge said.
- Yellow eye rockfish averaged .5 parts per million but went as high as 1.3.
- Spiny dogfish averaged .8 parts per million and went as high as 1.3.

Mercury is a natural element found in the earth and also comes from man-made sources such as coal-fired power plants.

Besides testing fish, the state Department of Health also offers to test mercury levels in women of childbearing age. The mercury level is gauged from a hair sample. Women interested should ask their health providers about it, Verbrugge said.

Of 359 Alaska women tested from 2002 through 2006, all were well below the rate of 14 parts per million, the level that would have any effect on a fetus, she said.

Daily News reporter Rosemary Shinohara can be reached at rshinohara@adn.com or 257-4340.

Mercury concentration

Under 1 part per million has no effect

Species Min.* Max.

Shark 1.2 1.6

Lincoln .5 1.4

Spiny dogfish .8 1.3

Yellow eye rockfish .5 1.3

Halibut .3 1.9

* In parts per million

Source: State Dept. Environmental Conservation

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Bob Gurlach

EPA

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