

GREAT LAKES INDIAN FISH & WILDLIFE COMMISSION

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MICHIGAN

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Lac du Flambeau Band
Red Cliff Band
St. Croix Chippewa
Sokaogon Chippewa

MINNESOTA

Fond du Lac Band
Mille Lacs Band

To: Ann McCammon-Soltis, Director of Intergovernmental Affairs

From: Matt Hudson, Environmental Biologist *Matt Hudson*

Date: September 30, 2007

Re: Reporting Results for Cisco Contaminant Testing Under U.S. EPA Grant Number GL00E06501:

Attached are results for cisco contaminant testing under U.S. EPA Grant Number: GL00E06501. Also included are brief descriptions of the fish processing and analytical methods used to produce the data. Please note that “lake herring” are now referred to as “cisco.” The scientific name (*Coregonus artedii*) has not changed, but to be consistent with current nomenclature, the term “cisco” will be used to describe what had been referred to as “lake herring,” except when describing documents that already exist for this project.

The objectives of this study as stated in the EPA-approved Quality Assurance Project Plan (QAPP) entitled “Lake Herring Collection, Compositing, and Environmental Chemical Contaminant Analysis Quality Assurance Project Plan” were to:

1. Determine the wet weight of each fillet’s skin, lipid dense trimmings, and muscle tissue collected from cisco captured in management unit WI-2.
2. Determine the concentration of chemicals listed in Table 2 in 16 composite muscle samples; lipid and moisture content in 16 composite muscle, 16 lipid-dense, and 16 skin samples; and archive these 48 composite samples from management unit WI-2.
3. Based on tissue wet weights and lipid and chemical content, mathematically estimate the chemical concentration in skin-on trimmed fillets and skin-on untrimmed fillets.
4. Compare the mean chemical composite values of the skin-off trimmed fillet (i.e. muscle tissue), skin-on trimmed fillets and skin-on untrimmed fillets to the U.S. Food and Drug Administration’s environmental chemical concentration limits for the sale of fish.

The project grant proposal and QAPP also state that results were to be compared to state guidelines for contaminant levels in fish tissue, other Lake Superior cisco data that are available and to GLIFWC's contaminant data on other Lake Superior fish species. These comparisons are included in this report.

Methods

Cisco Collection and Storage

Lake Superior cisco (*Coregonus artedii*), hereafter referred to as cisco, were collected on November 20, 2006 using gillnets near Chebomnicon Bay on the east side of Madeline Island (47° 026 N, 90° 43.016 W) in Lake Superior lake trout fisheries management unit WI-2 (Figure 1). Four length ranges of cisco were collected: 13.0-13.5 inches (in) (33-34 centimeters [cm]), 15.0-15.5 in (38-39 cm), 16.0-16.5 in (41-42 cm), and 17.5-18.5 in (45-47 cm). Cisco were measured in inches during field collection but were converted to centimeters for data analysis purposes. These length ranges differed slightly from original length ranges developed from commercial cisco harvest data in Michigan waters of Lake Superior. Data from Michigan waters were used to provide a best estimate for field sampling because cisco harvest from Wisconsin waters is not typically monitored for fish length. During field sampling, an insufficient number of large cisco were available, so adjustments to the length ranges were made to accommodate the length range of cisco being captured (Table 1). These changes are reflected in Section B of the approved project QAPP.

Samples were handled in a similar manner to commercially harvested fish and placed on ice as they were collected on the boat. Samples were frozen intact within 24 hours of collection and remained frozen (at temperatures at or below -10°C) until processing at the analytical laboratory. The date, time, and conditions of collection and storage were documented on chain-of-custody forms.

Cisco Processing into Composites

Total length and aging material (otoliths) were collected from each fish prior to freezing. The Great Lakes Indian Fish and Wildlife Commission's (GLIFWC) Great Lakes Fisheries Section aged the fish to the nearest year. Fish were selected for each composite group based on length and age. Cisco were processed into composites at the Lake Superior Research Institute (LSRI), University of Wisconsin-Superior in January and February of 2007.

Fish were thawed before processing. Individual cisco were filleted using a stainless steel knife. Fillets were segmented into skin, dorsal/ventral fatty tissue (fat), and muscle tissue. Each individual fillet component (i.e. skin, fat, muscle) was weighed separately, ground, and an equal weight of ground tissue used to form a composite. On the first, middle and final processing day, a can of commercial chunk light tuna (*Thunnus sp.*) was divided in half. One half was processed in the same manner as the cisco composites and the other half was transferred directly to an amber sample jar. These samples were used as procedural blanks to check for contamination that may have been introduced during

processing. They were analyzed for total mercury but not for the organic chemicals. All lab utensils and glassware were critically cleaned between each composite. Moisture analyses were conducted on the composites. Remaining composite tissues were transferred to critically cleaned amber glass jars with Teflon lids and archived in a freezer at temperatures at or below -10°C.

Chemical Extraction and Analysis

Each of the 16 muscle tissue composite samples was analyzed for 37 chemicals (Table 2). Mercury was analyzed by LSRI according to LSRI SOP SA/13, *Cold Vapor Mercury Analysis in Biota*, based on EPA Method 245.6. Percent moisture was determined by LSRI using LSRI SOP NT/15 *Procedures for Determining Percent Moisture in Tissue Samples*.

Organic chemicals were analyzed by Pace Analytical, Inc. located in Green Bay, WI. The organic chemicals were extracted according to Pace SOP KM-O-001 (based on EPA SW846 Method 3540C). Percent lipid was determined by Pace SOP KM-L-003, based on Standard Methods for the Examination of Water and Wastewater # 5520, 1992. Lipids were removed from the sample extracts using gel permeation chromatography (Pace SOP KM-O-004, based on EPA SW846 Method 3640A). Following removal of lipids, the samples were filtered through a silica gel column to separate the chlorinated pesticides from the PCBs (Pace SOP KM-O-012, based on EPA SW846 Method 3630C). The final extracts were analyzed for PCBs according to Pace SOP KM-O-002 (based on EPA Method 8082) and chlorinated pesticides according to Pace SOP KM-O-014 (based on EPA Method 8081A).

A more complete description of the methods can be found in the QAPP for this project entitled “Lake Herring Collection, Compositing, and Environmental Chemical Contaminant Analysis Quality Assurance Project Plan”.

Results

Quality Control

Results from quality control (QC) analyses used to monitor data quality for the organic chemical analyses can be found in Tables 3 - 7. QC results from the total mercury analyses can be found in Tables 8 - 11. A Laboratory Data Review Checklist (GLIFWC SOP AD.006) was used to help complete the data review process. Overall, the sample data were in good agreement with the quality assurance parameters, so the data were determined to be precise and accurate (Appendix A).

Objective #1 - Determine the wet weight of each fillet’s skin, lipid dense trimmings, and muscle tissue collected from cisco captured in management unit WI-2.

Table 12 lists descriptive data including tag number, sex, age, and length, along with the weight of the whole fillet, muscle, skin, and fat tissues for the 64 cisco that were sorted

into composite samples. An equal weight of tissue from each fish was used to form each composite. These data were recorded but are not reported in this memo.

Objective #2 - Determine the concentration of chemicals listed in Table 2 in 16 composite muscle samples; lipid and moisture content in 16 composite muscle, 16 lipid-dense, and 16 skin samples; and archive these 48 composite samples from management unit WI-2.

Objective #3 - Based on tissue wet weights and lipid and chemical content, mathematically estimate the chemical concentration in skin-on trimmed (SOT) fillets and skin-on untrimmed (SOUT) fillets.

Table 13 provides skin and fat tissue composite mean \pm one standard deviation percent moisture and percent lipid measurements. Table 14 provides the cisco data by composite and by chemical. Table 14 also includes mean \pm one standard deviation of muscle composite chemical concentrations for each size group and estimated mean \pm one standard deviation of chemical concentrations in SOT and SOUT fillets. These estimates were calculated using the assumption that organic, PBT contaminants partition primarily to the lipid tissue of organisms (Mackay 1982) and were based on tissue weights recorded during fish tissue processing, and percent lipid measured in each tissue. Regression statistics for six of the most frequently detected organic contaminants plotted against percent lipid in cisco muscle tissue are provided as a test of the lipid assumptions used (Table 15).

All tissue composites were archived at LSRI in critically cleaned amber glass jars with Teflon lids, frozen at temperatures at or below -10°C .

Objective #4 - Compare the mean chemical composite values of the skin-off trimmed raw fillet, skin-on trimmed fillets (SOT) and skin-on untrimmed (SOUT) fillets to the U.S. Food and Drug Administration's environmental chemical concentration limits for the sale of fish.

The United States Food and Drug Administration (FDA) regulates the sale of fish based on concentrations of various chemicals measured in fish fillets that are to be sold commercially. Table 16 compares Lake Superior cisco muscle tissue concentrations of chemicals and chemical groups to FDA concentration limits for those chemicals/groups. All cisco muscle tissue concentrations, along with SOT and SOUT fillet estimated concentrations were below current FDA fish tissue concentration limits.

GLIFWC conducted a study of PBT contaminants in Lake Superior fish (including cisco) in 1999. Table 17 compares concentrations of three chemicals measured in cisco muscle tissue composites in 1999 to those measured in the current study (2006).

Other Study Objectives Addressed

1) Compare cisco consumption advice issued by each state (Michigan, Minnesota, and Wisconsin) for Lake Superior.

Table 18 provides current fish consumption advisory trigger level and “do not eat” concentrations used by jurisdictions around Lake Superior. Figures 2A and 2B show the current Lake Superior cisco consumption advice issued by Michigan, Minnesota, and Wisconsin.

2) Compare GLIFWC cisco data to advisory trigger levels used to set fish consumption advice by Michigan, Minnesota, and Wisconsin.

Figures 3-5 compare GLIFWC cisco data to current fish advisory trigger and “do not eat” levels for total PCBs, mercury and total chlordane that are used by Michigan, Minnesota, and Wisconsin to set fish consumption advice. The values are meant to be used as benchmarks for comparison and not to describe how a jurisdiction would interpret the data or set fish consumption advice based on these data.

3) Compare cisco data collected in this study to that collected by Michigan, Minnesota, and Wisconsin for fish advisory purposes.

Table 19 summarizes Lake Superior cisco fillet data collected by Michigan, Minnesota, Wisconsin, and GLIFWC over the past ten years (1996-2006). Results are combined for each jurisdiction from this time period and are intended to give a broad indication of whether mercury and PCB data from cisco collected by different jurisdictions were being detected at similar concentrations across Lake Superior.

GLIFWC has conducted similar studies to the current cisco study across common, tribally harvested size ranges of siscowet trout (*Salvelinus namaycush siscowet*, 1999), lake trout (*Salvelinus namaycush namaycush*, 2003) and lake whitefish (*Coregonus clupeaformis*, 2004). Comparisons between siscowet trout, lake trout, lake whitefish and cisco are shown for total mercury in Figure 6 and for total PCBs in Figure 7.

References

Mackay, D. Correlation of bioconcentration factors. *Environmental Science and Technology*. 1982. 16: 274-278.

Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory. 1993. Great Lakes Sport Fish Advisory Task Force.

United States Food and Drug Administration. 2001. *Fish and Fisheries Products Hazards and Control Guidance*. Third Edition.

cc Neil Kmiecik, Biological Services Director
John Coleman, Environmental Section Leader
James Thannum, Planning Director

TABLES

Table 1. Original and field-modified target length ranges and mean length and age (\pm one standard deviation) for the four composites within each Lake Superior cisco (*Coregonus artedii*) size group.

Common Name	Genus Species	Target Length Range, Planned (in)	Target Length Range, Actual (in)	Target Length Range, Actual (cm)	Mean Length (cm)	Mean age (yr)
Cisco	<i>Coregonus artedii</i>	13.5 to 14.5	13.0 to 13.5	33 to 34	33.8 \pm 0.5	5.6 \pm 2.7
Cisco	<i>Coregonus artedii</i>	15.5 to 16.5	15.0 to 15.5	38 to 39	39.2 \pm 0.4	6.8 \pm 1.7
Cisco	<i>Coregonus artedii</i>	17.5 to 18.5	16.0 to 16.5	41 to 42	41.1 \pm 0.4	7.9 \pm 1.3
Cisco	<i>Coregonus artedii</i>	19.5 to 20.5	17.5 to 18.5	45 to 47	45.5 \pm 1.1	10.9 \pm 3.2

Table 2. Chemical and non-chemical analyses conducted on muscle tissue (e.g. trimmed, skin-off fillets) composite samples of Lake Superior cisco (*Coregonus artedii*).

No	Chemical Analyses	Lab Conducting Analysis	No	Chemical Analyses	Lab Conducting Analysis
1	Total Chlordane	Calculated by GLIFWC	22	Toxaphene	Pace
2	Cis-Chlordane	Pace	23	Aldrin	Pace
3	Trans-Chlordane	Pace	24	Dieldrin	Pace
4	Cis-nonachlor	Pace	25	Heptachlor	Pace
5	Trans-nonachlor	Pace	26	Heptachlor epoxide	Pace
6	Oxychlordane	Pace	27	Endrin Ketone	Pace
7	Total PCBs	Pace	28	Methoxychlor	Pace
8	1016	Pace	29	Hexachlorobenzene	Pace
9	1221	Pace	30	Mirex	Pace
10	1232	Pace	31	Pentachloroanisole	Pace
11	1242	Pace	32	Endosulfan	Pace
12	1248	Pace	33	Endrin	Pace
13	1254	Pace	34	Endosulfan sulfate	Pace
14	1260	Pace	35	Endrin aldehyde	Pace
15	Total DDT	Calculated by GLIFWC	36	α -benzene hexachloride	Pace
16	4,4'-DDT	Pace	37	β -benzene hexachloride	Pace
17	4,4'-DDE	Pace	38	δ -benzene hexachloride	Pace
18	4,4'-DDD	Pace	39	γ -benzene hexachloride	Pace
19	2,4'-DDT	Pace	40	Total mercury	LSRI
20	2,4'-DDE	Pace	41	Lipid Determination	Pace
21	2,4'-DDD	Pace	42	Moisture Determination	LSRI

Table 3. Relative percent agreement (RPA*) of PCB and pesticide concentrations in duplicate Lake Superior cisco (*Coregonus artedii*) samples analyzed by Pace, Inc.

Compound	CA33-34TF1	CA33-34TF1 DUP	RPA	CA45-47TF4	CA45-47TF4 DUP	RPA	QC Limits RPA
Arochlor 1016	ND	ND	.	ND	ND	.	60
Arochlor 1221	ND	ND	.	ND	ND	.	60
Arochlor 1232	ND	ND	.	ND	ND	.	60
Arochlor 1242	ND	ND	.	ND	ND	.	60
Arochlor 1248	ND	ND	.	ND	ND	.	60
Arochlor 1254	ND	ND	.	ND	ND	.	60
Arochlor 1260	ND	ND	.	21	19	91.3	60
Total PCBs	ND	ND	.	21	19	91.3	60
2,4'-DDD	ND	ND	.	ND	ND	.	60
2,4'-DDE	ND	ND	.	ND	ND	.	60
2,4'-DDT	ND	ND	.	ND	ND	.	60
4,4'-DDD	ND	ND	.	ND	ND	.	60
4,4'-DDE	ND	3.0	.	6.9	6.1	87.7	60
4,4'-DDT	ND	ND	.	ND	ND	.	60
Aldrin	ND	ND	.	ND	ND	.	60
alpha-BHC	ND	ND	.	ND	ND	.	60
alpha-Chlordane	ND	ND	.	1.5	1.4	93.1	60
beta-BHC	ND	ND	.	ND	ND	.	60
cis-nonachlor	0.88	1.2	73.3	2.9	2.5	85.2	60
delta-BHC	ND	ND	.	ND	ND	.	60
Dieldrin	2.3	3.8	60.5	2.0	1.9	94.9	60
Endosulfan I	ND	ND	.	ND	ND	.	60
Endosulfan II	ND	ND	.	ND	ND	.	60
Endosulfan Sulfate	ND	ND	.	ND	ND	.	60
Endrin	ND	ND	.	ND	ND	.	60
Endrin Aldehyde	ND	ND	.	ND	ND	.	60
Endrin Ketone	ND	ND	.	ND	ND	.	60
gamma-BHC (Lindane)	ND	ND	.	ND	ND	.	60
gamma-Chlordane	ND	ND	.	ND	ND	.	60
Heptachlor	ND	ND	.	ND	ND	.	60
Heptachlor Epoxide	ND	ND	.	ND	ND	.	60
Hexachlorobenzene	ND	ND	.	ND	ND	.	60
Methoxychlor	ND	ND	.	ND	ND	.	60
Mirex	ND	ND	.	ND	ND	.	60
Oxychlordane	ND	ND	.	ND	ND	.	60
Pentachloroanisole	ND	ND	.	ND	ND	.	60
Toxaphene	ND	ND	.	78	ND	.	60
Trans-nonachlor	1.6	1.5	93.3	3.3	2.6	76.3	60

ND - Not Detectable - sample was below detection limit.

*RPA is: $1 - (\text{absolute value of the difference between the two samples} / \text{mean of the two samples})$

Table 4. Relative percent agreement (RPA*) of lipid concentration in duplicate Lake Superior cisco (*Coregonus artedii*) samples analyzed by Pace, Inc.

Date of Analysis	Composite No.	Sample 1	Sample 2	RPA*	QC Limit RPA
3/8/2007	CA3334TF1	2.04	2.17	93.8	>65
3/8/2007	CA4547TF4	2.17	2.10	96.7	>65
3/28/2007	CA3334L1	11.9	12.0	99.2	>65
3/28/2007	CA3334S1	15.0	14.6	97.3	>65

*RPA is: $1 - (\text{absolute value of the difference between the two samples} / \text{mean of the two samples})$

Table 5. Percent spike recovery of PCBs and pesticides in two Lake Superior cisco (*Coregonus artedii*) samples analyzed by Pace, Inc.

Compound	Sample 1 CA38-39TF2	Sample 2 CA38-39TF2DUP	QC Limits Recovery	RPA*	QC Limits RPA
Aroclor 1254	91	91	43-130	99.8	44
4,4'-DDD	95	86	48-160	90.2	62
4,4'-DDE	93	96	46-152	96.9	60
4,4'-DDT	99	86	49-148	85.4	68
Aldrin	100	99	52-122	99.2	62
alpha-BHC	88	89	69-123	98.9	89
alpha-Chlordane	102	96	52-139	94.8	62
beta-BHC	86	94	35-128	90.9	64
delta-BHC	91	89	57-126	97.3	77
Dieldrin	81	77	42-135	94.6	56
Endosulfan I	77	70	45-140	90.5	70
Endosulfan II	98	93	46-147	94.1	55
Endosulfan Sulfate	95	92	54-132	97.4	78
Endrin	87	80	43-136	91.5	61
Endrin Aldehyde	40	27	6-96	64.1	50
Endrin Ketone	91	87	61-139	96.0	74
gamma-BHC (Lindane)	84	85	52-126	99.1	65
gamma-Chlordane	85	83	55-136	97.1	67
Heptachlor	68	69	50-128	98.9	65
Heptachlor Epoxide	100	93	51-130	92.8	50
Methoxychlor	74	72	36-159	96.5	50

*RPA is: $1 - (\text{absolute value of the difference between the two samples} / \text{mean of the two samples})$

Table 6. Percent spike recovery of PCBs and pesticides in lab control spikes (LCS) and spike duplicates (LCS dup) analyzed by Pace, Inc.

Compound	QC Batch Number: 18613			QC Batch Number: 19235			QC Limits Recovery	QC Limits RPD
	LCS Recovery	LCS dup Recovery	LCS/LCS dup RPA**	LCS Recovery	LCS dup Recovery	LCS/LCS dup RPA		
Aroclor 1254	101	105	95.5	92	95	97	40-128	60
2,4'-DDD	135*	150*	89.5	.	.	.	70-130	60
2,4'-DDE	38*	31*	79.7	.	.	.	70-130	60
2,4'-DDT	120	110	91.3	.	.	.	70-130	60
4,4'-DDD	99	100	99.1	95	85	88.3	63-128	60
4,4'-DDE	111	114	97.4	115	116	98.8	60-150	60
4,4'-DDT	98	97	99.8	94	81	84.5	62-127	60
Aldrin	107	109	98.0	115*	101	87.0	60-110	60
alpha-BHC	93	99	93.6	94	82	86.1	65-117	60
alpha-Chlordane	96	102	94.1	96	82	83.7	58-125	60
beta-BHC	92	94	98.0	94	80	83.5	58-109	60
cis-nonachlor	210*	220*	95.3	.	.	.	70-130	60
delta-BHC	103	100	96.9	106	85	78.2	63-117	60
Dieldrin	90	87	97.3	92	78	83.3	63-117	60
Endosulfan I	83	83	99.2	86	74	84.4	54-129	60
Endosulfan II	105	100	95.2	109	90	80.2	57-120	60
Endosulfan Sulfate	101	99	97.4	108	85	76.6	61-123	60
Endrin	95	89	93.4	95	77	79.1	55-116	60
Endrin Aldehyde	53	45	83.6	48	30	52.7*	16-75	60
Endrin Ketone	94	91	97.2	98	79	77.9	64-132	60
gamma-BHC (Lindane)	91	94	97.6	92	77	81.9	65-115	60
gamma-Chlordane	86	92	93.9	80	70	86.5	64-120	60
Heptachlor	78	80	97.7	82	76	93.4	58-118	60
Heptachlor Epoxide	102	103	98.4	100	86	84.6	63-118	60
Hexachlorobenzene	90	90	100	.	.	.	60-140	60
Methoxychlor	75	75	99.4	86	71	80.9	33-141	60
Mirex	110	110	100	.	.	.	60-140	60
Oxychlordane	110	120	91.3	.	.	.	70-130	60
Pentachloroanisole	50*	37*	70.1	.	.	.	70-130	60
Toxaphene	105	110	95.3	.	.	.	60-140	60
trans-Nonachlor	120	125	95.9	.	.	.	70-130	60

* Spiked sample recovery not within control limits.

** RPA is: $1 - \frac{|x - y|}{\frac{x + y}{2}}$ (absolute value of the difference between the two samples/mean of the two samples)

Table 7. Results of Standard Reference Material (SRM) analysis. SRM-1946 was the Certified Standard Reference Material used. SRM 1 and 2 refer to the SRM 1946 samples analyzed by Pace, Inc. Results are compared to Quality Control (QC) ranges issued for SRM 1946 and to Pace's QC ranges for the same analytes.

Compound Name	SRM 1946 Conc. µg/Kg	SRM 1946 Uncertainty	SRM QC Range (ug/kg)		SRM 1	SRM 2	En Chem Matrix spike QC limits	En Chem QC Range (ug/kg)		SRM 1	SRM 2
Alpha-BHC	5.72	±0.65	6.37	5.07	5.2	7.7*	69-123	3.7	6.7	5.2	7.7*
Gamma-BHC	1.14	±0.18	1.32	0.96	1	1.1	57-126	0.7	1.3	1	1.1
Heptachlor epoxide	5.50	±0.23	5.73	5.27	6.7*	7.7*	51-130	3.5	6.5	6.7*	7.7*
Dieldrin	32.5	±3.5	36.0	29.0	32	36	42-135	20	38	32	36
4,4'-DDE	373	±48	421	325	330	360	46-152	224	560	330	360
4,4'-DDD	17.7	±2.8	20.5	14.9	8.6*	10*	48-160	11	27	8.6*	10*
4,4'-DDT	37.2	±3.5	40.7	33.7	45*	60*	49-148	23	47	45	60*
Alpha-chlordane	32.5	±1.8	33.3	30.7	29*	34*	52-139	19	41	29	34
Gamma-chlordane	8.36	±0.91	9.27	7.45	11*	12*	55-136	4.6	11	11	12*
2,4'-DDD	2.20	±0.25	2.45	1.95	0*	0*	70-130	1.5	2.9	0*	0*
Cis-nonachlor	59.1	±3.6	62.7	55.5	70*	78*	70-130	41	77	70	78*
Trans-nonachlor	99.6	±7.6	107	92.0	68*	82*	70-130	70	129	68	82
Oxychlordane	18.9	±1.5	20.4	17.4	16*	17	70-130	13	25	16	17
Hexachlorobenzene	7.25	±0.83	8.08	6.42	8.4*	10*	70-130	5.1	9.4	8.4	10*
Mirex	6.47	±0.77	7.24	5.70	5.4*	5.6*	70-130	4.5	8.4	5.4	5.6

* Analyte concentration was outside of given quality control (QC) range.

Table 8. Relative percent agreement (RPA*) of total mercury concentrations in procedural blank samples (commercial tuna fish [*Thunnus sp.*]) before and after grinding or grinding and blending by LSRI.

Analysis Date	Grinding Date	Before Grinding (µg Hg/g)	After Grinding (µg Hg/g)	After Grinding/ Blending (µg Hg/g)	Mean (µg Hg/g)	Relative Percent Agreement
4/3/2007	1/24/2007	0.096	0.096		0.096	100.0
4/3/2007	1/24/2007	0.096		0.109	0.103	87.4
4/3/2007	2/1/2007	0.024	0.024		0.024	100.0
4/3/2007	2/1/2007	0.024		0.026	0.025	92.0
4/3/2007	2/22/2007	0.028	0.028		0.028	100.0
4/3/2007	2/22/2007	0.028		0.030	0.029	93.1

*RPA is: $1 - (\text{absolute value of the difference between the two samples} / \text{mean of the two samples})$

Table 9. Mercury concentrations of dogfish tissue supplied by the National Research Council Canada (DORM-2) and analyzed by LSRI. The tissue has a certified mercury concentration of 4.64 ± 0.26 $\mu\text{gHg/g}$ tissue. The acceptable range of mercury concentration was 3.40-5.24 $\mu\text{g Hg/g}$ based upon LSRI DORM-2 analyses conducted from 2003 through 2005.

Sample 1 ($\mu\text{g Hg/g}$)	Sample 2 ($\mu\text{g Hg/g}$)	Mean	Std. Dev.	Percent of Expected
4.63	4.58	4.60	0.04	99.1
4.60	4.42	4.51	0.13	97.2

Table 10. Relative percent agreement (RPA*) between duplicate analysis for total mercury (wet weight) content in skinless fillet tissue of composited Lake Superior cisco (*Coregonus artedii*) analyzed by LSRI.

Date of Analysis	Sample ID	Sample 1 ($\mu\text{g Hg/g}$)	Sample 2 ($\mu\text{g Hg/g}$)	Relative Percent Agreement
4/3/2007	CA33-34TF2	0.041	0.039	95.0
4/3/2007	CA45-47TF3	0.093	0.085	91.0

*RPA is: $1 - (\text{absolute value of the difference between the two samples} / \text{mean of the two samples})$

Table 11. Percent of total mercury recovered from skinless fillet tissue of composited Lake Superior cisco (*Coregonus artedii*) spiked with a known quantity of mercury by LSRI.

Date of Analysis	Sample ID	Spike #1	Spike #2	Mean	Std. Dev.
4/3/2007	CA33-34TF2	101	101	101	0.00
4/3/2007	CA45-47TF3	109	108	109	0.71

Table 12. Individual Lake Superior cisco (*Coregonus artedii*) descriptive data for fish contained in each composite. Tissue weights are wet weight values. These weights are not the weight of tissue used to form the composites.

Sample ID	Tag Num	Sex	Age (yr)	Length (in)	Length (cm)	Whole Fillet Wt (g)	Muscle Wt (g)	Fat Wt (g)	Skin Wt (g)
CA33-34-1	6553	F	2	13.0	33.0	165.8	122.8	20.1	18.8
CA33-34-1	1886	F	3	13.3	33.8	170.8	121.2	25.7	19.8
CA33-34-1	9296	M	3	13.0	33.0	177.1	133.4	17.0	24.1
CA33-34-1	7600	M	3	13.0	33.0	166.6	122.0	23.2	18.4
CA33-34-2	9295	F	3	13.5	34.3	200.0	144.7	29.0	21.3
CA33-34-2	6552	M	3	13.5	34.3	195.5	159.1	18.2	13.4
CA33-34-2	2080	M	4	13.4	34.0	159.0	124.0	11.1	26.2
CA33-34-2	9181	M	4	13.5	34.3	218.6	175.5	17.4	19.2
CA33-34-3	2087	F	6	13.4	34.0	222.7	175.4	21.0	21.8
CA33-34-3	9180	F	7	13.5	34.3	203.9	165.6	16.5	18.9
CA33-34-3	1884	F	8	13.2	33.5	181.3	149.1	11.3	16.1
CA33-34-3	9297	M	8	13.0	33.0	164.9	133.4	11.0	16.6
CA33-34-4	7598	M	8	13.5	34.3	230.6	180.3	19.9	25.4
CA33-34-4	6551	M	8	13.5	34.3	218.9	174.1	20.2	22.5
CA33-34-4	7599	M	9	13.5	34.3	220.5	179.6	20.6	16.9
CA33-34-4	2078	M	10	13.4	34.0	209.3	169.8	15.3	22.1
CA38-39-1	6587	M	3	15.5	39.4	359.0	303.4	20.9	28.8
CA38-39-1	1885	M	5	15.2	38.6	332.3	273.3	21.8	30.6
CA38-39-1	6593	F	5	15.5	39.4	355.7	282.3	27.0	39.5
CA38-39-1	6627	F	5	15.5	39.4	323.3	250.1	28.1	35.6
CA38-39-2	2063	M	6	15.4	39.1	365.0	292.5	26.9	40.6
CA38-39-2	2061	M	7	15.4	39.1	298.7	241.4	22.7	28.7
CA38-39-2	2077	M	7	15.4	39.1	278.8	224.0	20.2	29.2
CA38-39-2	6589	M	7	15.5	39.4	330.2	256.0	32.8	33.6
CA38-39-3	6591	F	7	15.5	39.4	297.8	230.0	33.2	26.0
CA38-39-3	6626	M	7	15.0	38.1	302.1	240.6	25.5	31.0
CA38-39-3	9179	F	7	15.3	38.9	268.6	204.0	28.5	26.1
CA38-39-3	2069	M	8	15.5	39.4	363.5	297.0	28.0	32.1
CA38-39-4	2071	F	8	15.5	39.4	274.1	212.8	30.5	26.8
CA38-39-4	2088	M	8	15.5	39.4	351.1	259.3	56.3	26.9
CA38-39-4	6628	M	8	15.5	39.4	325.7	251.0	38.4	29.9
CA38-39-4	6595	M	10	15.5	39.4	323.7	246.9	40.6	29.3
CA41-42-1	2034	F	6	16.0	40.6	322.9	255.5	28.6	32.0
CA41-42-1	6632	M	6	16.2	41.1	360.4	288.1	25.6	39.7
CA41-42-1	6634	F	6	16.1	40.9	354.3	295.0	19.3	38.0
CA41-42-1	2037	M	7	16.0	40.6	396.2	317.5	29.9	41.0
CA41-42-2	6625	F	7	16.1	40.9	329.7	266.5	24.4	31.8
CA41-42-2	2035	M	8	16.0	40.6	406.3	336.6	30.9	32.9
CA41-42-2	6629	F	8	16.2	41.1	405.0	321.3	42.5	34.7
CA41-42-2	2083	F	8	16.0	40.6	318.9	254.3	27.8	29.7
CA41-42-3	2036	F	8	16.5	41.9	368.0	276.9	37.2	45.2
CA41-42-3	6633	M	8	16.5	41.9	408.0	349.0	24.2	29.5
CA41-42-3	6635	F	8	16.3	41.4	473.3	395.0	43.0	29.4
CA41-42-3	6636	M	8	16.2	41.1	376.8	304.4	31.2	35.3
CA41-42-4	2033	M	9	16.2	41.1	382.7	308.3	33.5	32.2
CA41-42-4	6630	M	9	16.3	41.4	371.8	292.6	35.0	36.6

Table 12 Continued...

Sample ID	Tag Num	Sex	Age (yr)	Length (in)	Length (cm)	Whole Fillet Wt (g)	Muscle Wt (g)	Fat Wt (g)	Skin Wt (g)
CA41-42-4	2038	F	10	16.0	40.6	385.3	294.0	40.6	38.7
CA41-42-4	6631	M	10	16.0	40.6	356.6	286.0	33.1	36.9
CA45-47-1	6594	F	8	17.4	44.2	461.4	376.4	29.3	43.2
CA45-47-1	6586	F	9	17.4	44.2	453.8	376.3	30.3	39.1
CA45-47-1	2081	F	8	17.7	45.0	528.1	430.6	38.6	47.1
CA45-47-1	2041	F	7	17.6	44.7	437.9	366.6	28.3	37.9
CA45-47-2	2040	M	10	17.4	44.2	484.4	395.4	44.0	36.9
CA45-47-2	2074	M	10	18.1	46.0	572.3	457.3	52.4	50.8
CA45-47-2	6584	F	10	17.7	45.0	474.6	366.0	58.2	43.2
CA45-47-2	2073	F	11	17.7	45.0	458.8	370.2	NA	38.8
CA45-47-3	2039	M	8	18.5	47.0	583.6	473.6	52.5	49.8
CA45-47-3	6585	F	9	18.5	47.0	530.7	425.9	48.5	46.4
CA45-47-3	2076	M	10	18.5	47.0	505.6	410.5	40.8	44.5
CA45-47-3	6598	M	11	18.2	46.2	555.6	458.0	42.1	47.0
CA45-47-4	2075	F	14	18.4	46.7	513.0	423.6	32.8	45.6
CA45-47-4	2090	F	18	18.5	47.0	550.4	446.1	47.8	48.1
CA45-47-4	2042	M	15	17.9	45.5	500.8	399.9	48.1	43.8
CA45-47-4	6596	M	16	17.4	44.2	490.6	400.7	39.6	43.0

NA = Not Available

Table 13. Percent lipid and mean \pm one standard deviation of percent moisture measured in fat and skin tissues from Lake Superior cisco (*Coregonus artedii*) composites.

Sample ID	Fat			Skin		
	% Lipid	Mean % Moisture	STDEV	% Lipid	Mean % Moisture	STDEV
CA33-34-1	12.0*	67.8	0.2	14.8*	61.8	0.5
CA33-34-2	16.1	62.3	0.5	16.0	60.3	0.5
CA33-34-3	18.4	61.4	0.8	15.6	59.8	0.6
CA33-34-4	17.6	62.0	0.4	13.4	62.9	1.5
CA38-39-1	25.2	53.9	0.6	19.9	53.1	1.5
CA38-39-2	23.0	55.5	0.8	18.8	57.2	0.2
CA38-39-3	19.0	60.7	1.4	17.6	58.3	0.7
CA38-39-4	19.2	61.3	1.2	17.0	57.6	0.9
CA41-42-1	25.1	54.1	0.9	21.2	53.6	1.0
CA41-42-2	17.8	63.4	0.7	15.0	62.3	0.6
CA41-42-3	19.5	60.0	0.5	16.6	60.1	0.5
CA41-42-4	21.9	57.3	0.5	17.4	60.0	0.8
CA45-47-1	24.6	53.0	0.3	19.6	57.4	2.6
CA45-47-2	23.2	61.7	1.1	16.5	59.6	0.2
CA45-47-3	23.7	57.1	1.2	17.7	58.6	0.1
CA45-47-4	14.2*	66.2	0.8	8.85*	67.9	0.2

* Value listed is the mean of duplicate samples.

Table 14. Individual Lake Superior cisco (*Coregonus artedii*) muscle tissue composite chemical concentrations. Concentrations listed for skin-on trimmed fillets (SOT) and skin-on untrimmed fillets (SOUT) are estimated values based on the wet weight of tissues in the composites and percent lipid in those tissues. Mean and standard deviation concentrations for each length group do not include “not-detected (ND) results. “Percent Moisture” data for each composite are the average of three replicates. Values given for “Percent Moisture” and Percent Lipid” are percentages. All other data are wet weight concentrations in units of µg/kg. Significant figures are consistent with lab reported values.

Chemical Parameter	Limit Of Detection	Limit Of Quantitation	Length Group*	Composite Number				Replicate**		Length Group Average***	Length Group STDEV	Skin-on Trimmed (SOT) Fillet Average	Skin-on Trimmed (SOT) Fillet STDEV	Skin-on Untrimmed (SOUT) Fillet Average	Skin-on Untrimmed (SOUT) Fillet STDEV
				1	2	3	4	1	2						
Percent Moisture			33 to 34 cm	75.7	75.2	75.0	76.2			75.5	0.5	.	.	.	.
			38 to 39 cm	74.0	75.4	75.4	74.4			74.8	0.7	.	.	.	.
			41 to 42 cm	73.9	74.6	75.8	75.7			75.0	0.9	.	.	.	.
			45 to 47 cm	74.6	74.2	74.0	75.4			74.6	0.6	.	.	.	.
Percent Moisture Standard Deviation			33 to 34 cm	0.1	0.2	0.3	0.3			0.2	.	.	.	.	.
			38 to 39 cm	0.2	0.1	0.1	0.4			0.2	.	.	.	.	.
			41 to 42 cm	0.2	0.2	0.2	0.2			0.2	.	.	.	.	.
			45 to 47 cm	0.2	0.3	0.1	0.1			0.2	.	.	.	.	.
Percent Lipids			33 to 34 cm	2.11	2.84	2.61	2.42	2.04	2.17	2.49	0.31	3.94	0.33	4.98	0.34
			38 to 39 cm	1.80	3.09	2.80	3.05			2.69	0.60	4.38	0.47	5.86	0.53
			41 to 42 cm	4.13	3.67	3.15	3.17			3.53	0.47	5.01	0.74	6.27	0.78
			45 to 47 cm	4.68	3.62	3.29	2.14	2.17	2.10	3.43	1.05	4.63	1.36	5.97	1.55
2,4'-DDD	0.63	2.1	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
2,4'-DDE	0.83	2.8	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
2,4'-DDT	0.73	2.4	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.

Table 14 continued...

Chemical Parameter	Limit Of Detection	Limit Of Quantitation	Length Group*	Composite Number				Replicate**		Length Group Average***	Length Group STDEV	Skin-on Trimmed (SOT) Fillet Average	Skin-on Trimmed (SOT) Fillet STDEV	Skin-on Untrimmed (SOUT) Fillet Average	Skin-on Untrimmed (SOUT) Fillet STDEV
				1	2	3	4	1	2						
4,4'-DDD	1.5	5.0	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
4,4'-DDE	2.1	7.0	33 to 34 cm	3.0	ND	ND	3.1	ND	3.0	3.1	0.1	4.6	.	6.1	.
			38 to 39 cm	ND	3.0	2.7	5.8			3.8	1.7	5.8	2.4	7.8	3.6
			41 to 42 cm	ND	5.2	4.5	3.7			4.5	0.8	6.2	0.6	7.9	0.5
			45 to 47 cm	5.3	5.2	4.4	6.5	6.9	6.1	5.4	0.9	7.3	1.2	9.5	1.7
4,4'-DDT	1.8	5.9	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	2.5	ND	ND			2.5	.	3.3	.	4.0	.
			45 to 47 cm	ND	2.0	ND	ND	ND	ND	2.0	.	2.7	.	3.7	.
Aldrin	1.0	3.3	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Alpha-BHC	1.3	4.2	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
alpha-Chlordane	0.97	3.2	33 to 34 cm	1.0	1.0	ND	1.4	ND	1.0	1.1	0.2	1.8	0.4	2.3	0.6
			38 to 39 cm	ND	1.4	1.3	2.1			1.6	0.4	2.5	0.6	3.3	0.9
			41 to 42 cm	ND	2.2	1.5	2.1			1.9	0.4	2.7	0.5	3.4	0.7
			45 to 47 cm	2.1	1.7	1.6	1.5	1.5	1.4	1.7	0.3	2.3	0.3	3.0	0.3
Aroclor 1016	19	63	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.

Table 14 continued...

Chemical Parameter	Limit Of Detection	Limit Of Quantitation	Length Group*	Composite Number				Replicate**		Length Group Average***	Length Group STDEV	Skin-on Trimmed (SOT) Fillet Average	Skin-on Trimmed (SOT) Fillet STDEV	Skin-on Untrimmed (SOUT) Fillet Average	Skin-on Untrimmed (SOUT) Fillet STDEV
				1	2	3	4	1	2						
Aroclor 1221	19	63	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Aroclor 1232	19	63	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Aroclor 1242	19	63	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Aroclor 1248	19	63	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Aroclor 1254	19	63	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Aroclor 1260	19	63	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	20	21	19	20	.	27	.	36	.
Beta-BHC	1.9	6.3	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.

Table 14 continued...

Chemical Parameter	Limit Of Detection	Limit Of Quantitation	Length Group*	Composite Number				Replicate**		Length Group Average***	Length Group STDEV	Skin-on Trimmed (SOT) Fillet Average	Skin-on Trimmed (SOT) Fillet STDEV	Skin-on Untrimmed (SOUT) Fillet Average	Skin-on Untrimmed (SOUT) Fillet STDEV
				1	2	3	4	1	2						
cis-Nonachlor	0.72	2.4	33 to 34 cm	1.0	1.1	0.9	1.7	0.88	1.2	1.2	0.4	1.8	0.5	2.3	0.7
			38 to 39 cm	ND	1.6	1.3	2.6			1.8	0.7	2.8	0.9	3.8	1.5
			41 to 42 cm	1.2	4.4	2.9	2.9			2.9	1.3	4.0	1.6	5.0	2.1
			45 to 47 cm	3.8	3.5	3.4	2.7	2.9	2.5	3.4	0.5	4.6	0.5	5.9	0.7
Delta-BHC	0.91	3.0	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Dieldrin	1.7	5.7	33 to 34 cm	3.05	2.7	2.3	3.2	2.3	3.8	2.8	0.4	4.2	0.5	5.3	0.8
			38 to 39 cm	ND	2.6	2.5	3.0			2.7	0.3	4.2	0.3	5.5	0.6
			41 to 42 cm	3.3	3.7	2.8	3.1			3.2	0.4	4.6	0.4	5.7	0.5
			45 to 47 cm	4.2	3.5	2.8	2.0	2.0	1.9	3.1	1.0	4.2	1.2	5.4	1.4
Endosulfan I	1.0	3.5	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Endosulfan II	1.5	4.9	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Endosulfan Sulfate	2.0	6.7	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Endrin	2.1	6.9	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.

Table 14 continued...

Chemical Parameter	Limit Of Detection	Limit Of Quantitation	Length Group*	Composite Number				Replicate**		Length Group Average***	Length Group STDEV	Skin-on Trimmed (SOT) Fillet Average	Skin-on Trimmed (SOT) Fillet STDEV	Skin-on Untrimmed (SOUT) Fillet Average	Skin-on Untrimmed (SOUT) Fillet STDEV
				1	2	3	4	1	2						
Endrin Aldehyde	1.2	4.0	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	1.9			1.9	.	2.8	.	3.8	.
			45 to 47 cm	2.0	1.9	1.8	ND	ND	ND	1.9	0.1	2.6	0.0	3.3	0.2
Endrin Ketone	3.1	10	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
gamma-BHC (Lindane)	0.72	2.4	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
gamma-Chlordane	1.6	5.2	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Heptachlor	1.0	3.4	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Heptachlor Epoxide	1.3	4.3	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Hexachlorobenzene	2.2	7.2	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.

Table 14 continued...

Chemical Parameter	Limit Of Detection	Limit Of Quantitation	Length Group*	Composite Number				Replicate**		Length Group Average***	Length Group STDEV	Skin-on Trimmed (SOT) Fillet Average	Skin-on Trimmed (SOT) Fillet STDEV	Skin-on Untrimmed (SOUT) Fillet Average	Skin-on Untrimmed (SOUT) Fillet STDEV
				1	2	3	4	1	2						
Methoxychlor	8.0	27	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Mirex	1.2	4.1	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Oxychlorane	0.95	3.2	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Pentachloroanisole	0.83	2.8	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
Total Chlordane	sum of - alpha-Chlordane, gamma-Chlordane, cis-Nonachlor, trans-Nonachlor, Oxychlorane		33 to 34 cm	3.1	3.8	2.2	5.7	2.5	3.7	3.7	1.5	5.6	2.2	7.1	3.0
			38 to 39 cm	0.87	5.3	4.9	8.4			4.9	3.1	7.6	4.4	10	6.1
			41 to 42 cm	3.7	11	7.5	7.7			7.5	3.0	10	3.7	13	4.7
			45 to 47 cm	9.0	7.8	8.4	7.1	7.7	6.5	8.1	0.8	11	0.9	14	1.1
Total DDT	sum of - 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'DDT		33 to 34 cm	3.0	ND	ND	3.1	ND	3.0	3.1	0.1	5.1	0.6	6.5	0.5
			38 to 39 cm	ND	3.0	2.7	5.8			2.9	1.7	5.8	2.4	7.8	3.6
			41 to 42 cm	ND	7.7	4.5	3.7			5.3	2.1	7.3	2.4	9.2	2.6
			45 to 47 cm	5.3	7.2	4.4	6.5	6.9	6.1	5.9	1.2	8.0	1.6	10	2.6
Total Mercury****	4.2	14	33 to 34 cm	37	32	32	46			37	6.6	.	.	.	.
			38 to 39 cm	36	40	56	69	41	39	50	15	.	.	.	.
			41 to 42 cm	38	72	60	61			58	14	.	.	.	.
			45 to 47 cm	71	87	89	130	93	85	94	25	.	.	.	.

Table 14 continued...

Chemical Parameter	Limit Of Detection	Limit Of Quantitation	Length Group*	Composite Number				Replicate**		Length Group Average***	Length Group STDEV	Skin-on Trimmed (SOT) Fillet Average	Skin-on Trimmed (SOT) Fillet STDEV	Skin-on Untrimmed (SOUT) Fillet Average	Skin-on Untrimmed (SOUT) Fillet STDEV
				1	2	3	4	1	2						
				Total PCBs	19	63	33 to 34 cm	ND	ND						
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			45 to 47 cm	ND	ND	ND	20	21	19	20	.	27	.	36	.
Toxaphene	64	210	33 to 34 cm	ND	ND	ND	ND	ND	ND	ND	.	ND	.	ND	.
			38 to 39 cm	ND	ND	ND	ND			ND	.	ND	.	ND	.
			41 to 42 cm	ND	120	ND	ND			120	.	160	.	190	.
			45 to 47 cm	100	ND	ND	78	78	ND	89	16	120	21	150	15
trans-Nonachlor	0.67	2.2	33 to 34 cm	1.6	1.7	1.3	2.6	1.6	1.5	1.8	0.6	2.9	0.8	3.6	1.1
			38 to 39 cm	0.87	2.3	2.3	3.7			2.3	1.2	3.6	1.5	4.9	2.1
			41 to 42 cm	2.5	3.9	3.1	2.7			3.1	0.6	4.3	0.6	5.4	0.7
			45 to 47 cm	3.1	2.6	3.4	3.0	3.3	2.6	3.0	0.3	4.2	0.6	5.4	0.8

ND = Not detected

* Length groups in centimeters correspond approximately to inches as follows: 33 to 34 cm = 13.0 to 13.5 inches; 38 to 39 cm = 15.0 to 15.5 inches; 41 to 42 cm = 16.0 to 16.5 inches; and 45 to 47 cm = 17.5 to 18.5 inches.

** For the 33 to 34 cm length group, the values for composite 1, and for the 45 to 47 cm length groups, the values for composite 4, represent the average of two replicates.

*** "ND" values were treated as "0" and were not included in length group average calculations.

**** Duplicate measurements for total mercury analysis were run on composite 2 of the 38 to 39 cm length group and composite 3 of the 45 to 47 cm length group. Total mercury concentrations were not calculated for SOT and SOUT fillets because mercury binds to muscle tissue and is not reduced by trimming fillets.

Table 15. Statistics for the six most detected organic contaminants in Lake Superior cisco (*Coregonus artedii*) muscle tissue regressed against percent lipid in muscle tissue to test lipid partitioning assumptions used in estimating chemical concentrations in SOT and SOUT fillets.

Chemical or Chemical group	Number of Samples >LOD	r-squared	p-value	slope
Total Chlordane*	16	0.33	0.02	2.1
alpha-Chlordane	13	0.46	0.01	0.41
cis-Nonachlor	15	0.27	0.05	0.85
trans-Nonachlor	16	0.31	0.02	0.63
Total DDT	12	0.16	0.2	1.0
Dieldrin	15	0.57	0.001	0.61

* Total Chlordane is the sum of alpha-Chlordane, gamma-Chlordane, cis-Nonachlor, trans-Nonachlor, and Oxychlordane

Table 16. Lake Superior cisco (*Coregonus artedii*) mean, standard deviation, and range of chemical concentrations ($\mu\text{g}/\text{kg}$) in muscle tissue, skin-on trimmed fillets (SOT) and skin-on, untrimmed fillets (SOUT) for each composite length group. Results for SOT and SOUT fillets are estimated values based on the wet weight of tissues in the composites and percent lipid in those tissues. United States Food and Drug Administration (FDA) fish tissue concentration levels regulating the commercial sale of fish are given for each chemical or chemical group. Mean and standard deviations in bold refer to one or more composites within that length group were not included in calculations because of “not-detected” (ND) results.

Chemical Parameter	Tissue***	Cisco Length Group (cm)	Mean Conc. ****	St. Dev.	Range	FDA Level ($\mu\text{g}/\text{kg}$)
Total Mercury**	M	33-34	37	6.6	32-46	1000*****
	M	38-39*	50	15	36-69	
	M	41-42	58	14	38-72	
	M	45-47*	94	25	71-130	
Total PCBs	M	33-34*	ND	.	ND	2000
	M	38-39	ND	.	ND	
	M	41-42	ND	.	ND	
	M	45-47*	20	.	ND-20	
	SOT	33-34*	ND	.	ND	
	SOT	38-39	ND	.	ND	
	SOT	41-42	ND	.	ND	
	SOT	45-47*	27	.	ND-27	
	SOUT	33-34*	ND	.	ND	
	SOUT	38-39	ND	.	ND	
	SOUT	41-42	ND	.	ND	
	SOUT	45-47*	36	.	ND-36	
Total Chlordane	M	33-34*	3.7	1.5	2.2-5.7	300
	M	38-39	4.9	3.1	0.87-8.4	
	M	41-42	7.5	3.0	3.7-11	
	M	45-47*	8.1	0.8	7.1-9.0	
	SOT	33-34*	5.6	2.2	3.4-8.5	
	SOT	38-39	7.6	4.4	1.8-12	
	SOT	41-42	10	3.7	5.5-14	
	SOT	45-47*	11	0.9	9.3-12	
	SOUT	33-34*	7.1	3.0	4.2-11	
	SOUT	38-39	10	6.1	2.5-17	
	SOUT	41-42	13	4.7	6.6-17	
	SOUT	45-47*	14	1.1	12-16	
Total DDT	M	33-34*	3.1	0.1	ND-3.1	5000
	M	38-39	2.9	1.7	ND -5.8	
	M	41-42	5.3	2.1	ND -7.7	
	M	45-47*	5.9	1.2	4.4-7.2	
	SOT	33-34*	5.1	0.6	ND -5.5	
	SOT	38-39	5.8	2.4	ND -8.6	
	SOT	41-42	7.3	2.4	ND -10	
	SOT	45-47*	8.0	1.6	7.0-9.7	
	SOUT	33-34*	6.5	0.5	ND -6.9	
	SOUT	38-39	7.8	3.6	ND -12	
SOUT	41-42	9.2	2.6	ND -12		
SOUT	45-47*	10	2.6	8.2-13		
Aldrin/Dieldrin	M	33-34*	2.8	0.4	2.3-3.2	300
	M	38-39	2.7	0.3	ND-3.0	
	M	41-42	3.2	0.4	2.8-3.7	
	M	45-47*	3.1	1.0	2.0-4.2	
	SOT	33-34*	4.2	0.5	3.5-7.0	
	SOT	38-39	4.2	0.3	ND-4.4	
	SOT	41-42	4.6	0.4	3.9-4.9	
	SOT	45-47*	4.2	1.2	2.5-5.5	
	SOUT	33-34*	5.3	0.8	4.4-8.7	
	SOUT	38-39	5.5	0.6	ND-6.2	
SOUT	41-42	5.7	0.5	5.0-6.1		
SOUT	45-47*	5.4	1.4	3.4-6.5		

Table 16 Continued...

Chemical Parameter	Tissue***	Cisco Size Group (cm)	Mean Conc. ****	St. Dev.	Range	FDA Level (µg/kg)
Heptachlor/Heptachlor Epoxide	M	33-34*	ND	.	ND	300
	M	38-39	ND	.	ND	
	M	41-42	ND	.	ND	
	M	45-47*	ND	.	ND	
	SOT	33-34*	ND	.	ND	
	SOT	38-39	ND	.	ND	
	SOT	41-42	ND	.	ND	
	SOT	45-47*	ND	.	ND	
	SOUT	33-34*	ND	.	ND	
	SOUT	38-39	ND	.	ND	
	SOUT	41-42	ND	.	ND	
	SOUT	45-47*	ND	.	ND	
Mirex	M	33-34*	ND	.	ND	100
	M	38-39	ND	.	ND	
	M	41-42	ND	.	ND	
	M	45-47*	ND	.	ND	
	SOT	33-34*	ND	.	ND	
	SOT	38-39	ND	.	ND	
	SOT	41-42	ND	.	ND	
	SOT	45-47*	ND	.	ND	
	SOUT	33-34*	ND	.	ND	
	SOUT	38-39	ND	.	ND	
	SOUT	41-42	ND	.	ND	
	SOUT	45-47*	ND	.	ND	

ND = Not Detected

* These ranges include the mean of duplicate samples, i.e. duplicates were not treated as separate samples for inclusion in the concentration ranges.

** Because mercury binds to muscle tissue, trimming the fillet will not reduce mercury concentrations. Therefore, mercury concentrations were not calculated for SOT and SOUT fillets.

*** M = trimmed, skin-off muscle tissue; SOT = skin-on, trimmed fillet; SOUT = skin-on, untrimmed fillet.

**** Only samples above the limit of detection were used to calculate mean concentrations.

***** The FDA action level for mercury is for methylmercury. Generally >95% of mercury in top predator fish such as lake trout is methylmercury (GLIFWC data, unpublished).

Table 17. Comparison of Lake Superior cisco (*Coregonus artedii*) contaminant data collected by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) in 1999 and 2006. Data from 1999 were only collected from skin-on untrimmed fillets (SOUT) and the cisco were collected from lake trout management unit MI-4 (2006 data were collected from management unit WI-2). Thus, except for total mercury, 2006 estimates for SOUT fillets are used for comparison. Cisco composite size group (cm), mean chemical concentration (ug/kg), and concentration range (µg/kg) are given for three chemicals/chemical groups.

Chemical Parameter	2006 Data (SOUT Estimate)			1999 Data (SOUT)		
	Cisco Size Group	Mean Conc.	Range	Cisco Size Group	Mean Conc.	Range
Total Mercury***	33-34	37	32-46			
	38-39*	50	36-69			
	41-42	58	38-72			
	45-47*	94	71-130	38-43	107	65-149
Total PCBs	33-34*	ND	ND			
	38-39	ND	ND			
	41-42	ND	ND			
	45-47*	36**	ND-36	38-43	68	61-75
Total Chlordane	33-34*	7.1	4.2-11			
	38-39	10	2.5-17			
	41-42	13	6.6-17			
	45-47*	14	12-16	38-43	22	21-23

* These ranges include the mean of duplicate samples, i.e. duplicates were not treated as separate samples for inclusion in the concentration ranges.

** "Mean" concentration for this length group is the result for one sample because all others were below the limit of detection.

*** Because mercury binds to muscle tissue, SOUT concentration estimates were not made for total mercury with the 2006 data. Results displayed for total mercury in 2006 are for muscle tissue.

Table 18. Current (as of 2007) trigger and “do not eat” (DNE) fish tissue concentrations (in µg/kg [parts per billion] wet weight) used by jurisdictions on the United States side of Lake Superior to set sport fish consumption advisories. More specific advice (such as a concentration defining one meal per week or per month) for some contaminants are available, but are not listed here. The listed contaminants are responsible for the majority of advisories on the U.S. side of Lake Superior*.

Jurisdiction	Mercury		Total PCBs *****		Toxaphene		Total Chlordane	
	Trigger	DNE	Trigger	DNE	Trigger	DNE	Trigger	DNE
Sensitive Populations **								
Wisconsin	50	>950	50	>1900	-	-	-	>5620
Minnesota	50	>950	50	>1900	-	-	-	-
Michigan ****	500	>1500	50	>1900	5000	-	300	-
General Population ***								
Wisconsin	160	-	50	>1900	-	-	-	-
Minnesota	160	>2800	50	>1900	-	-	-	-
Michigan ****	500	>1500	2000	-	5000	-	300	-

* In Ontario, 91% of Lake Superior advisories based on their 2007-08 guidance are caused by dioxins/furans and dioxin-like PCBs (Guide to Eating Ontario Sportfish 2007-2008 edition).

** The sensitive population is defined as women of childbearing age and children under the age of 15.

*** The general population is defined as men above age 15 and women beyond childbearing years or above age 15 and not planning to have children.

**** The Michigan Department of Community Health sets fish consumption advice for most contaminants including: total PCBs for the general population, toxaphene, dioxin TEQs, and total chlordane, based on the percentage of measured fish tissue concentrations that exceed the trigger level.

***** Total PCB advice for Wisconsin, Minnesota, and for sensitive populations in Michigan, is based on the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory, developed by the Great Lakes Sport Fish Advisory Task Force, September 1993.

Table 19. Summary of Lake Superior cisco total mercury and total PCB data collected by the Great Lakes Indian Fish & Wildlife Commission (GLIFWC), Minnesota Department of Natural Resources (MNDNR), Michigan Department of Environmental Quality (MI DEQ), and Wisconsin Department of Natural Resources (WDNR) between 1996 and 2006. Results are combined for each jurisdiction from this time period and are intended to give a broad indication of whether mercury and PCB data from cisco collected by different jurisdictions were being detected at similar concentrations across Lake Superior. Only fillet data results collected for fish advisory purposes are listed. Whole fish and other non-fillet data were not included in this summary. Results are a mix of composite samples and individual cisco. Concentrations are wet weight, listed in units of mg/kg or parts per million. Mean results are given along with \pm one standard deviation. Results below detection limits were not included in mean and standard deviation calculations.

Agency	Years of Data Collection	No. Analyses/ No. Fish**	Length Mean (cm)	Length Range (cm)	Mean total mercury	Total mercury range	Mean total PCBs (Aroclors)	Total PCB Range	Number of PCB Analyses Below Detection Limit
MNDNR	2000,2002, 2003,2005	26/43	37.7 \pm 2.9	34.0-45.2	0.09 \pm 0.03	0.03-0.137	0.03 \pm 0.01	0.01-0.06	2
WDNR	2001,2003, 2005	17/23	31.5 \pm 6.9	18.8-39.1	0.076 \pm 0.044	0.023-0.19	0.084 \pm 0.036	ND-0.14	7
GLIFWC*	1999,2006	20/112	40.2 \pm 3.9	33.3-46.7	0.069 \pm 0.035	0.032-0.168	0.062 \pm 0.015	ND-0.078	15
MIDEQ	No Data over this time period								

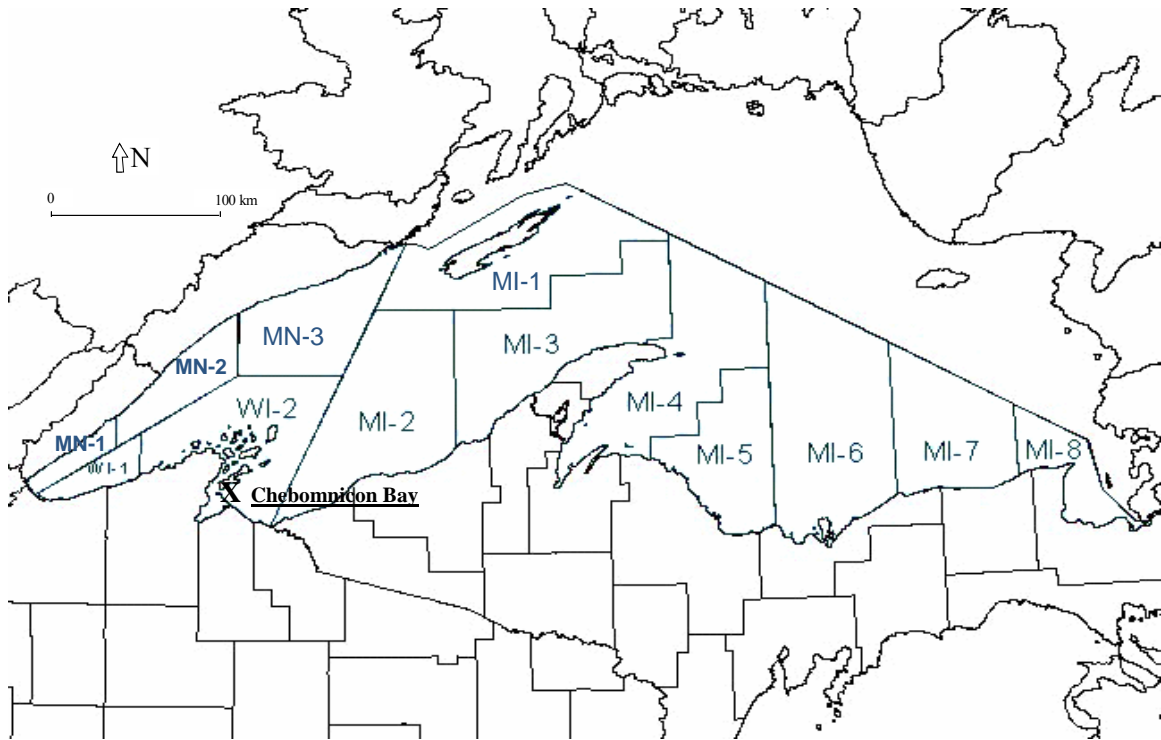
* GLIFWC segmented fillets into muscle, skin, and fat tissues. In 2006, chemical concentrations were only measured in trimmed, skin-off muscle tissue. PCB concentrations listed here are estimates for a skin-on, untrimmed fillet based on lipid normalized muscle concentrations and percent lipid in the skin and fat tissues. Total mercury concentrations for the GLIFWC 2006 samples are reported for muscle tissue only (i.e. the skin and fat have been removed unlike the other fillet samples listed in this table).

** No. Analyses/No. Fish = No. Analyses denotes the number of laboratory analyses the data represent. No. Fish denotes the number of fish represented in those analyses. When the two numbers are equal, individual fish were analyzed, when the numbers are not equal, composites were analyzed.

*** ND = Not Detected

FIGURES

Figure 1. Lake Superior lake trout management units (United States waters). Cisco samples were collected near Chebomnicon Bay on the southeast side of Madeline Island in lake trout management unit WI-2 (marked with an “X”).



Figures 2A and B. Comparison of Michigan, Minnesota and Wisconsin Lake Superior cisco (*Coregonus artedii*) consumption advice for sensitive populations (i.e. women of childbearing age and children under the age of 15, Figure A) and the general population (i.e. women beyond childbearing age and men above age 15, Figure B).

Figure 2A – Sensitive population

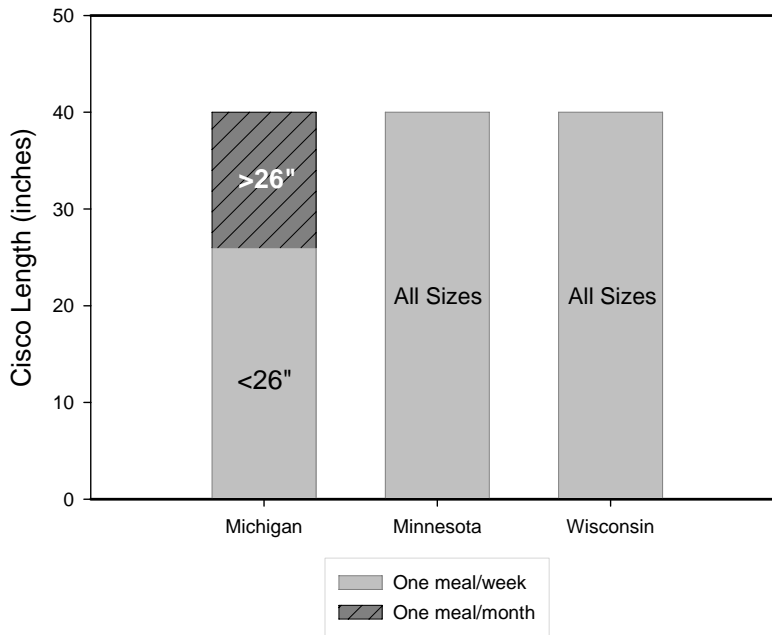


Figure 2B – General population

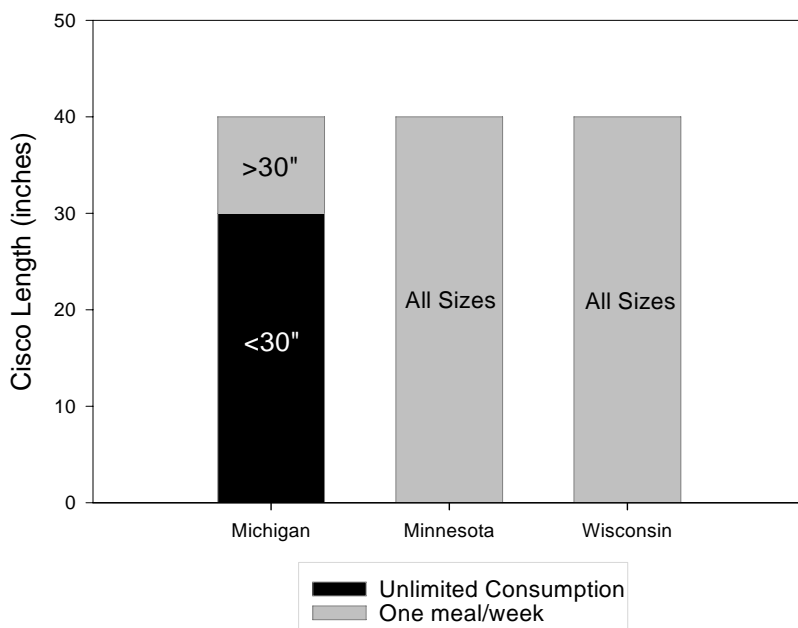


Figure 3. Total PCB concentrations (mean \pm one standard deviation) in Lake Superior cisco (*Coregonus artedii*) muscle tissue composites. Only one of the 16 composites (in the largest length group) had a detectable PCB concentration (“ND” means “Not Detected”). Concentrations in SOT and SOUT fillets are estimated based on muscle tissue concentrations and percent lipid in respective skin and fat tissues. SOT and SOUT refer to “skin on trimmed” and “skin on untrimmed” fillets. The trigger and “do not eat” fish tissue concentrations used by Michigan, Minnesota, and Wisconsin to set fish consumption advice are shown as lines. These states use values agreed upon in the “Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory” (Great Lakes Sport Fish Advisory Task Force, Sept. 1993).

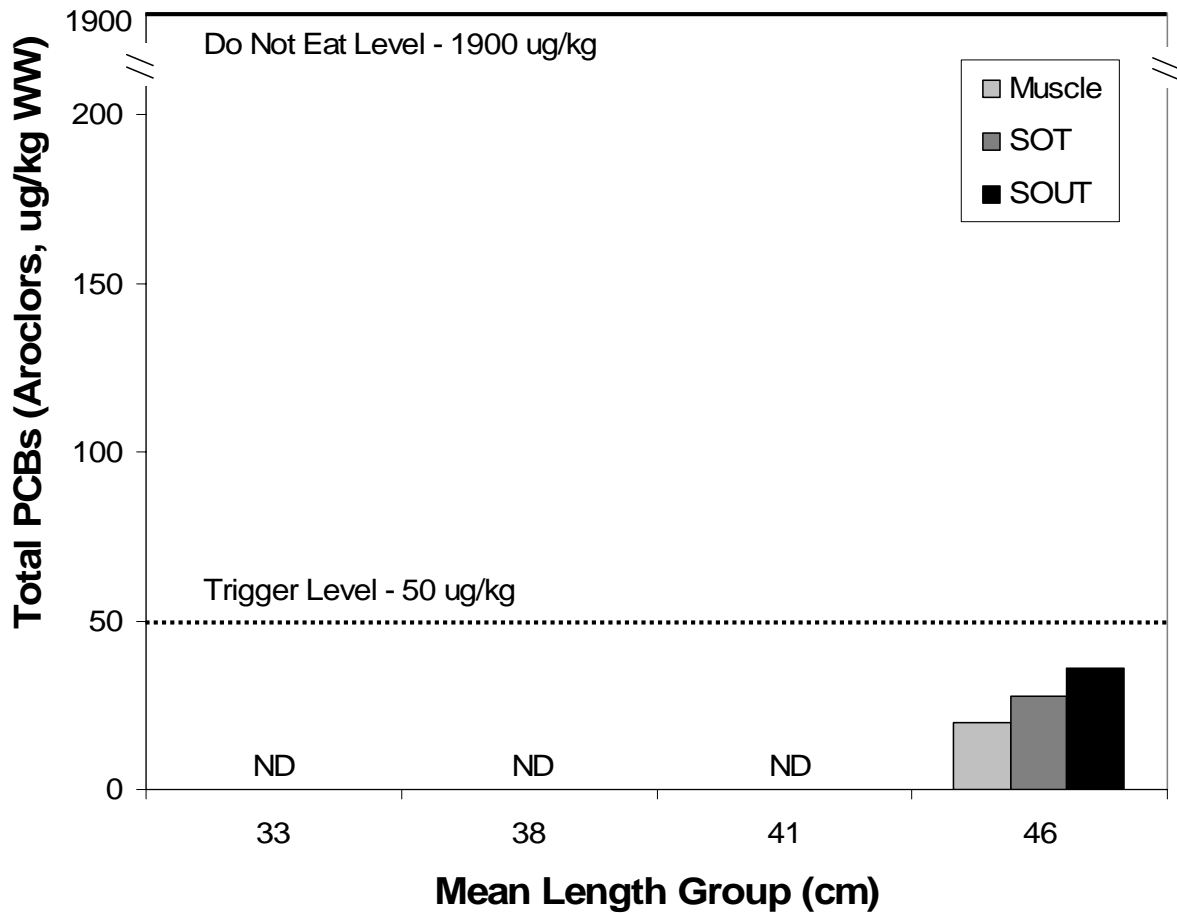


Figure 4. Total mercury concentrations (mean \pm one standard deviation) in Lake Superior cisco (*Coregonus artedii*) muscle tissue (i.e. trimmed, skin-off fillet) composites. Estimates of mercury concentrations in skin on trimmed (SOT) and skin on untrimmed fillets (SOUT) were not calculated because mercury binds to muscle tissue and cannot be removed by trimming a fillet. The trigger and “do not eat” fish tissue concentrations used by Michigan, Minnesota, and Wisconsin to set fish consumption advice are shown as lines.

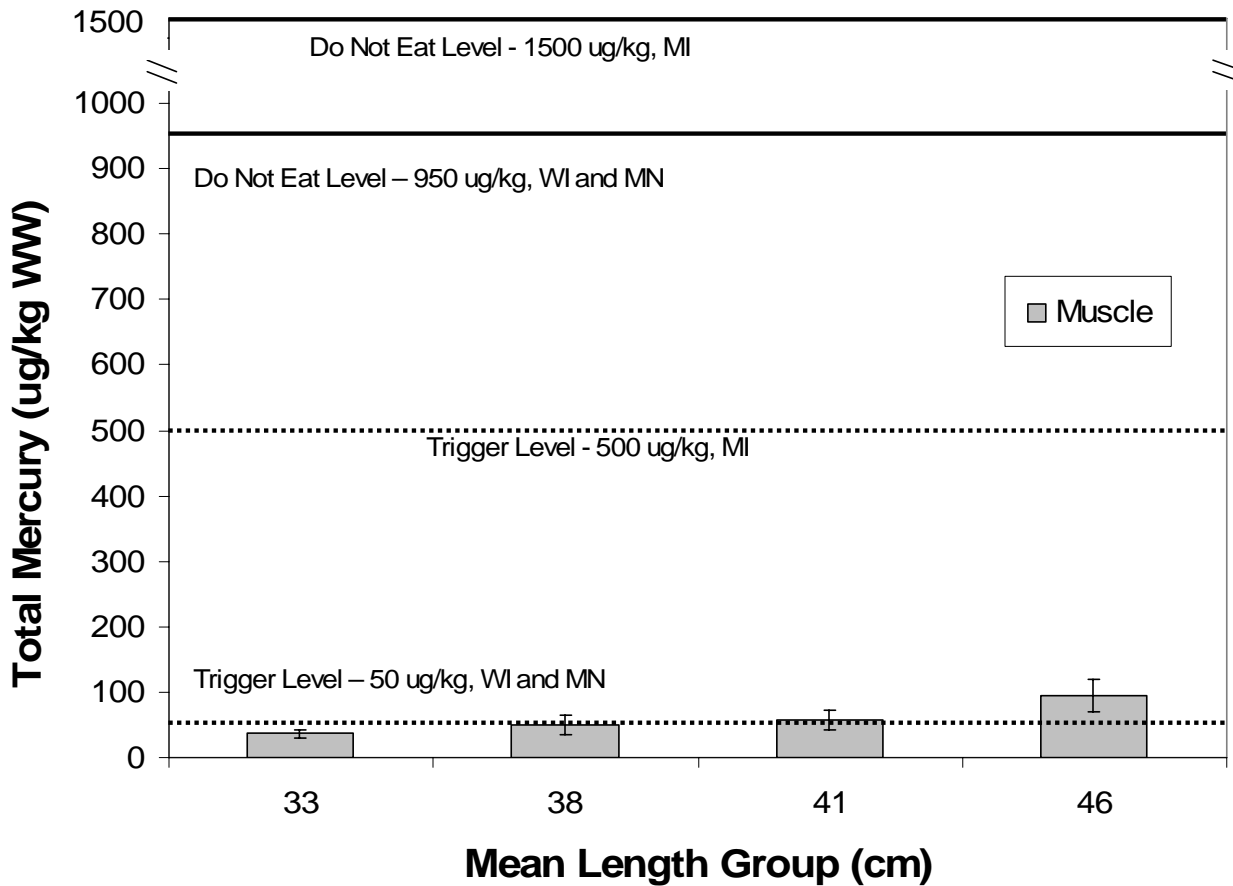


Figure 5. Total chlordane concentrations (mean \pm one standard deviation) in Lake Superior cisco (*Coregonus artedii*) muscle tissue composites. Concentrations in SOT and SOUT fillets are estimated based on muscle tissue concentrations and percent lipid in respective skin and fat tissues. SOT and SOUT refer to “skin on trimmed” and “skin on untrimmed” fillets. The trigger and/or “do not eat” fish tissue concentrations used by Michigan and Wisconsin to set fish consumption advice are shown as lines.

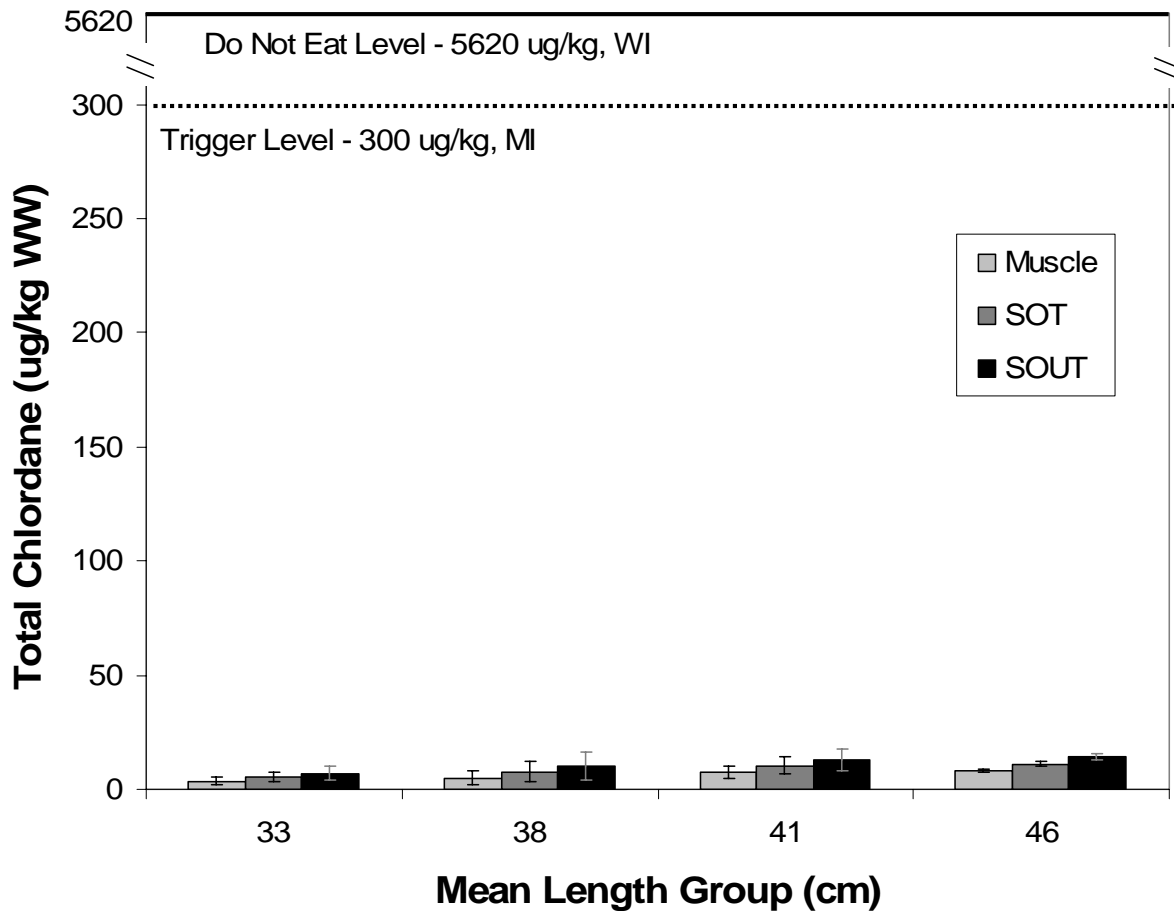


Figure 6. Total mercury concentrations (mean \pm one standard deviation) for four species of Lake Superior fish. The sizes of fish span the length range of each species commonly harvested by tribal commercial fishermen. Data for siscowet trout (*Salvelinus namaycush siscowet*), lake trout (*Salvelinus namaycush namaycush*) and whitefish (*Coregonus clupeaformis*) were previously reported by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC).

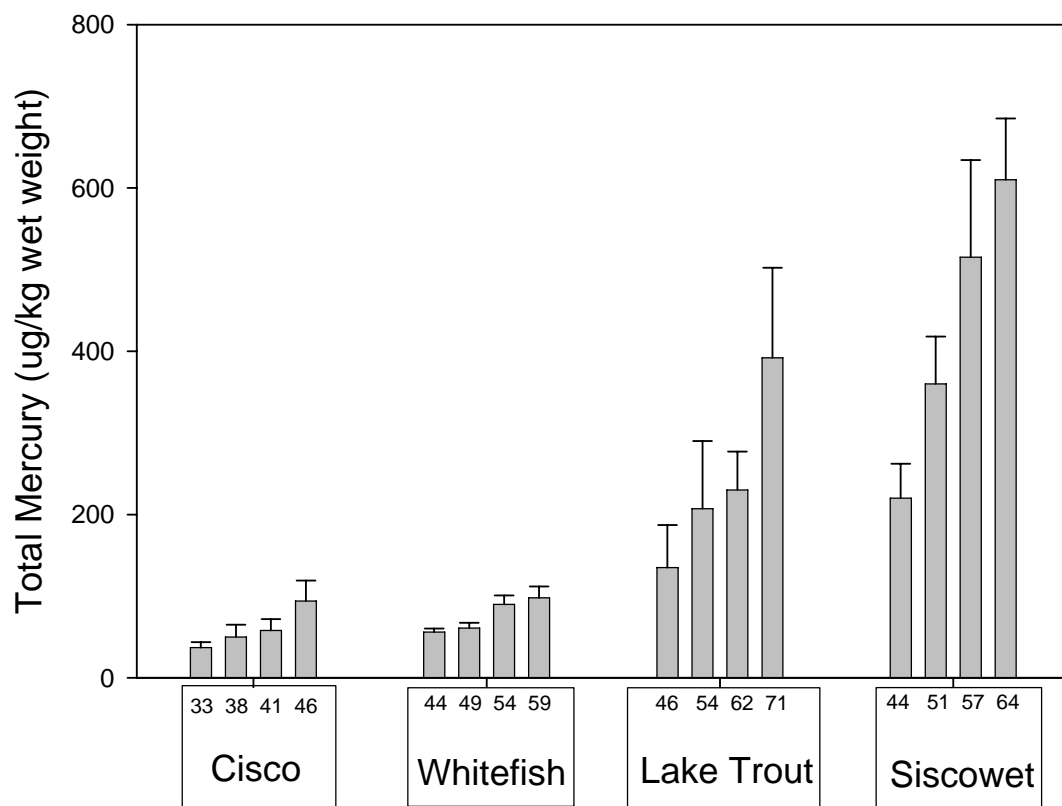
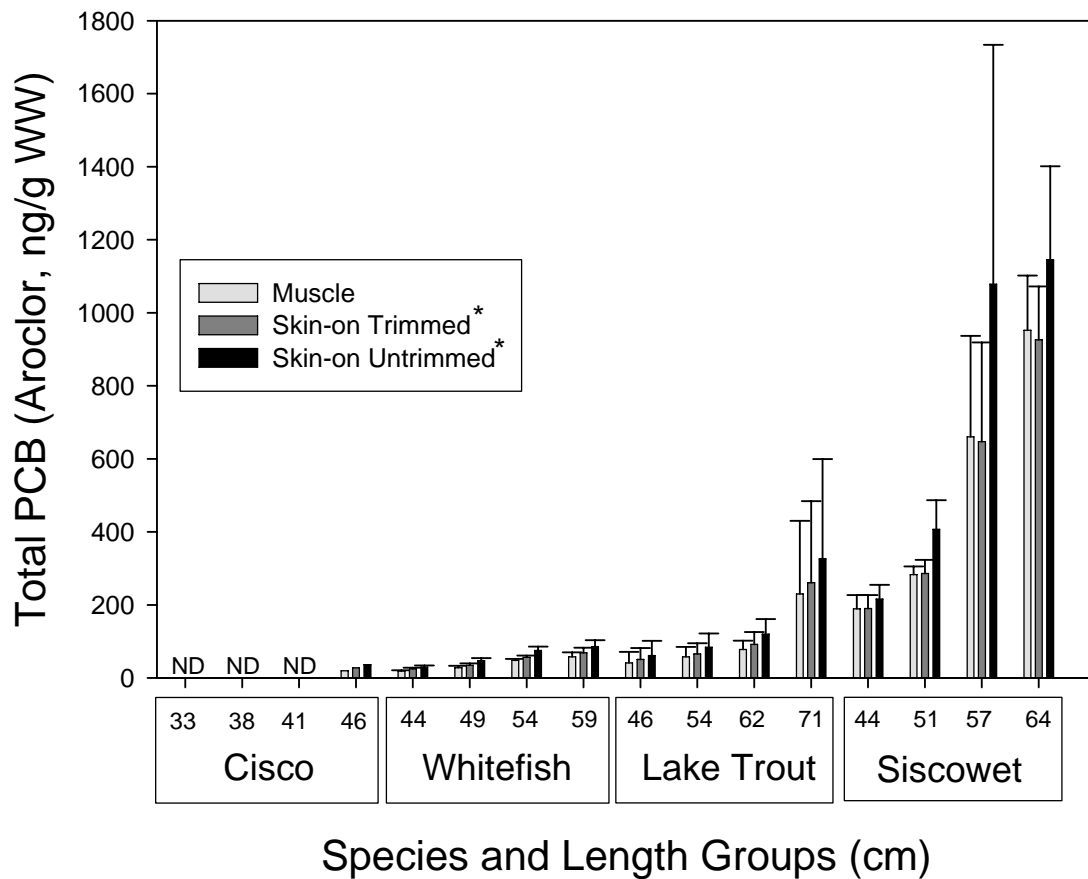


Figure 7. Total PCB concentrations (mean \pm one standard deviation) for four species of Lake Superior fish. The sizes of fish span the length range of each species commonly harvested by tribal commercial fishermen. Data for siscowet trout (*Salvelinus namaycush siscowet*), lake trout (*Salvelinus namaycush namaycush*) and whitefish (*Coregonus clupeaformis*) were previously reported by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). “ND” means “Not Detected.”



* Concentrations in “skin-on trimmed” and “skin-on untrimmed” fillets were measured for siscowet trout and estimated for lake trout, whitefish and cisco based on lipid normalized muscle tissue concentrations and skin and fat tissue lipid content.

APPENDICES

Appendix 1

**Laboratory Data Review Checklist for
U.S. EPA Grant Number GL00E06501**

Title: Laboratory Data Review Checklist

Introduction:

This procedure describes the data quality review process for evaluating chemical contaminant data received from contract laboratories.

Equipment:

Laboratory data review checklist (see attachment)
Black indelible ink pen

Procedure:

The GLIFWC project director or an appointed and properly trained GLIFWC staff member not involved in the project will perform this review.

Sampling Project: Lake Herring Contaminant Analysis

Date of Sampling: 11/2/06

Analytical Laboratory: Pace Analytical, Inc.

Mark each topic "Y," "N," or "NA" (not applicable), and comment as appropriate.

Y Final data package includes chain-of-custody forms.
Comment:

Y Chain-of-custody forms were properly completed and signed by everyone involved in transporting the samples.
Comment:

NA Laboratory records indicate sample custody seals were intact upon receipt.
Comment:

NA Samples arrived at the laboratory at the proper temperature.
Comment: Cooler on ice was documented & is appropriate - Note was made that

Y Samples were not frozen
All requested analyses were performed and were documented in the analytical report.
Comment: 8081A ← 8082 ← 2 SRM 2 LCS/LCS0 2 Method Blanks

Y 3510C ← 6PC ← 2 Dup 1 MS/MSD
Analyses were performed according to the methods specified in the approved QA Project Plan.
Comment: 3510C
8081A
8082
6PC

Y Holding times for extraction and analysis were not exceeded.
Comment: *According to case narrative*

Y Method detection and/or quantitation limits were included in the report.
Comment:

Y A Narrative summarizing the analyses and describing any analysis problems was included in the final report.
Comment:

Y Data qualifiers and flags were explained in the analytical report.
Comment:

Y Method (laboratory) blank results were included for all analyses, at the appropriate frequency, and showed no laboratory contamination.
Comment: *Note - 4,4' DDT was detected @ low level in one method blank - no action taken because 4,4' DDT was not found in the sample associated w/ this method blank.*

NA Initial calibration data (if requested from the laboratory) were within QAPP, method, or laboratory SOP defined acceptance criteria for all analyses.
Comment: *Wasn't requested but met criteria according to case narrative*

NA Continuing calibration data (if requested from the laboratory) were within QAPP, method, or laboratory SOP defined acceptance criteria for all analyses.
Comment:

Y Matrix spike data were included for all pertinent analyses for every 20 samples.
Comment:

Y Laboratory Control Sample data were included for all analyses for every 20 samples.
Comment:

Y Laboratory Duplicate data were included for all analyses for every 20 samples.
Comment:

NA Field blanks do not contain analytes of interest or interfering compounds and are included for all pertinent analyses for every 20 samples.
Comment:

Y Field Duplicates are within QAPP-defined acceptance criteria and are included for all analyses for every 10 samples.
Comment:

Y Matrix spike results were listed and within QAPP or laboratory defined acceptance criteria.

Comment:

Y Matrix interferences were definitively identified either through a second analysis or use of Laboratory Control Sample Results.

Comment: Potential bias of toxaphene in LCS was explained

Y Laboratory Control Sample results were within QAPP or laboratory defined acceptance criteria.

Comment: LCS samples fortified w/ CMix + Toxaphene had 8 AC limit exceedences - this was partially expected because of some compounds co-elute w/ Toxaphene (cis-nonachlor). Other exceedences were not compounds detected in the actual samples. The LCS fortified with the A/B Mix (no toxaphene) performed very well except for Aldrin (not detected in samples). Both the lake trout and whitefish studies had similar LCS results when spiked w/ toxaphene. It's possible the presence of toxaphene in the samples may bias some sample results, but this would be difficult to quantify.

Y Laboratory Duplicate results were within QAPP or laboratory defined acceptance criteria.

Comment: Not many analytes detected in samples - those detected were within 40% RPD in all

Y Reported results were within method detection or quantitation limits.

Comment:

Reviewer's Name (print): Matt Hudson

Reviewer's Signature: Matt Hudson

Reviewer's Title: Environmental Biologist

Address, Phone Number, and Email: P.O. Box 9 Odanah WI 54861 715-682-6619

Date of Data Review: 8/1/07
completion

*Note - This SOP is based on the model data review checklist found in EPA's CD-ROM Quality Assurance Project Plan Development Tool.